

PD SCIENCE

*Random, pre-1923 works of natural science
with a few lines of related verse.*

STAR-FISHES, by Elizabeth & Alexander Agassiz
THE LIPARI ISLANDS, STROMBOLI., by Edward Hull
THE TIME OF ROSES, by Thomas Hood
ROSES, by Nicholas Culpeper
THE CRAB SPIDER, by David & Marian Fairchild
BIRD LIFE IN WINTER, by W. H. Hudson
PALIMPSEST OF TWILIGHT, by D. H. Lawrence
THE DISCOVERY OF NEPTUNE, by Herbert H. Turner
PUSSY'S PATIENCE AND CLEANLINESS, by W. Gordon Stables
THE PREDACEOUS GROUND BEETLE, by David & Marian Fairchild
FEIGNED DISEASES, by W. G. A. Robertson
MOUNT HOFFMAN AND LAKE TENAYA, by John Muir
THE NIGHTINGALE, by Coleridge
FLEA-WORT, by Nicholas Culpeper
ALONG THE HILLSBOROUGH, by Bradford Torrey

STAR-FISHES.

from *Seaside Studies in Natural History*,
by Elizabeth C. Cary and Alexander Agassiz
EBook #35490

Star-fish. (_Astracanthion berylinus_ AG.)

Although there is the closest homology of parts between the Star-fish and the Sea-urchin, the arrangement of these parts, and the external appearance of the animals, as a whole, are entirely different. The Star-fish has zones corresponding exactly to those of the Sea-urchin, but instead of being drawn together, and united at the summit of the animal, so as to form a spherical outline, they are spread out on one level in the shape of a star. This change in the general arrangement brings the eye-specks to the extremities of the arms, and places the ovarian openings in the angles between the arms. The madreporic body is situated on the upper surface of the disk, at the angle between two of the arms, and consequently between two of the ambulacra, and opposite the odd one. The tube into which it opens, runs vertically from the upper floor of the disk to the lower, where it connects with the circular tube around the mouth, and thus communicates with all the ambulacral rows. The ambulacral zones which, in the Star-fish, have the shape of a furrow, run along the lower side of each ray; the interambulacral zones are divided, their plates being arranged in rows along either side of the ambulacral furrows. The ambulacral furrow, like the ambulacral zone in the Sea-urchin, is pierced with numerous holes, alternating with each other in a kind of zigzag arrangement, one hole a little in advance, the next a little farther back, and so on, and through these holes pass the tentacles, terminating in suckers, as in the Sea-urchins, and serving as in them for locomotive organs. The most prominent and strongest spines are arranged upon the large interambulacral plates on both sides of the ambulacral furrows; but the upper surface of the animal is also completely studded with smaller spines, scattered at various distances, apparently without any regular arrangement.

The position of the pedicellariæ is quite different from that which they occupy in the Sea-urchin, where they are scattered singly between the spines and tentacles, though more regularly and closely grouped along the lines upon which the refuse food is moved off. In the Star-fish, on the contrary, these singular organs seem to be grouped for some special purpose around the spines, on the upper surface of the body. Every such spine swells near its point of attachment, thus forming a spreading base, around which the pedicellariæ are

arranged in a close wreath, in the centre of which the summit of the spine projects; they differ also from those of the Sea-urchin in having two prongs instead of three. Other pedicellariæ are scattered independently over the surface of the animal, but they are smaller than those forming the clusters and connected with the spines. The function of these organs in the Star-fish remains unexplained; the opening on the upper surface, through which the refuse food is thrown out, is in such a position that they evidently do not serve here the same purpose which renders them so useful to the Sea-urchin. Occasionally they may be seen to catch small prey with these forks, little Crustacea, for instance; but this is probably not their only office. The Star-fish has a fourth set of external appendages in the shape of little water-tubes. The upper surface of the back consists of a strong limestone network, and certain openings in this network are covered with a thin membrane through which these water-tubes project. It is supposed that water may be introduced into the body through these tubes; but while there can be no doubt that they are constantly filled with water, and are therefore directly connected with the circulation through the madreporic body, no external opening has as yet been detected in them. The fact, however, that when these animals are taken out of their native element, the water pours out of them all over the surface of the back, so that they at once collapse and lose entirely their fulness of outline, seems to show that water does issue from those tubes. The ends of the arms are always slightly turned up, and at the summit of each is a red eye-speck. The tentacles about the eye become very delicate and are destitute of suckers.

These animals have singular mode of eating; they place themselves over whatever they mean to feed upon, as a cockle-shell for instance, the back gradually rising as they arch themselves above it; they then turn the digestive sac or stomach inside out, so as to enclose their prey completely, and proceed leisurely to suck out the animal from its shell. Cutting open any one of the arms we may see the yellow folds of the stomach pouches which extend into each ray; within the arms, extending along either side of the upper surface, are also seen the ovaries, like clusters of small yellow berries. Immediately below these, along the centre of the lower floor of each ray, runs the ridge formed by the ambulacral furrow, and upon either side of this ridge are placed the vesicles, by means of which the tentacles may be filled and emptied at the will of the animal; the rest of the cavity of the ray is filled by the liver. The mouth, which is surrounded by a circular tube, is not furnished with teeth, as in the Sea-urchin; but the end of each ambulacral ridge is hard, thus serving the purpose of teeth.

Cribrella. (*Cribrella oculata* FORBES.)

Our coast, as we have said, is not rich in the variety of Star-fishes. We have two large species, one of a dark-brown color, the *Astracanthion berylinus*, and the other, the *A. pallidus*, of a pinkish tint; then there is the small *Cribrella*, inferior in structural rank to the two above mentioned. This pretty little Star-fish presents the greatest variety of colors; some are dyed in Tyrian purple, others have a paler shade of the same hue, some are vermillion, others a bright orange or yellow. A glass dish filled with *Cribrellæ* might vie with a tulip-bed in gayety and vividness of tints.

The disk of the *Cribrella* is smooth, instead of being covered, like the larger Star-fishes, with a variety of prominent appendages. The spines are exceedingly short, crowded like little warts over the surface. It is an interesting fact, illustrating again the correspondence between the adult forms of the lower orders and the phases of growth in the higher ones, that these spines have an embryonic character. One would naturally expect to find that these small spines of the adult *Cribrella* would differ from those of the other full-grown Star-fishes chiefly in size, that they would be a somewhat modified pattern of the same thing on a smaller scale; but when examined under the microscope, they resemble the spines of the higher orders in their embryonic condition; it is not, in fact, a difference in size merely, but a difference in degree of development. The *Cribrella* moves usually with two of the arms turned backward, and the three others advanced together, the two posterior ones being sometimes brought so close to each other as to touch for their whole length.

Beside these Star-fishes we have the pentagonal *Hippasteria* (*Hippasteria phrygiana* AG.), like a red star with rounded points, found chiefly in deep water, though it is occasionally thrown up on the beaches. It has but two rows of large tentacles, terminating in a powerful sucking disk. The pedicellariæ on this Star-fish resemble large two-pronged clasps, arranged principally along the lower side. The pentagonal Star-fishes of our coast are in striking contrast to the long-armed species we have just described; they are edged with rows of large smooth plates, and do not possess the many prominent spines so characteristic of the ordinary Star-fishes.

The *Ctenodiscus* (*Ctenodiscus crispatus* D. & K.), an inhabitant of more northern waters, but seeming also to be at home

here occasionally, is another pentagonal Star-fish. It lives in deep water, and frequents muddy bottoms. The peculiar structure of their ambulacra has probably some reference to this mode of living, for they are entirely wanting in the sucking disks so characteristic of the other members of this class, and their tentacles are pointed, as if to enable them to work their way through the mud in which they make their home. The pointed tentacles of this genus are characteristic of a large group of Star-fishes, and it is an important fact, as showing their lower standing, that this feature, as well as the pentagonal outline, obtains in the earlier stages of growth of our more common Star-fishes, while in their adult condition they assume the deeply indented star-shaped outline, and have suckers at the extremities of the tentacles.

We find also among Star-fishes the same tendency to multiplication of parts so common among the Polyyps and Acalephs. Our *Solaster* (*Solaster endeca* Forbes), for instance, has no less than twelve arms; it inhabits more northern latitudes, though sometimes found in our Bay; on the coast of Maine it is quite common, and occurs in company with another many-rayed species, the *Crossaster papposa* M. & T. The color of both of these Star-fishes is exceedingly varied; we find in the *Solaster* as many different hues as in the *Cribrella*, which it resembles in the structure of its spines, while in the *Crossaster* bands of different tints of red and purple are arranged concentrically, and the whole surface of the back is spotted with brilliantly-tinged tiny wreaths of water-tubes, crowded round the base of the different spines, which are somewhat similar to those of the *Astracanthion*.

THE LIPARI ISLANDS, STROMBOLI.

from *Volcanoes: Past and Present*, by Edward Hull

EBook #31627

(_a._) A brief account of this remarkable group of volcanic islands must here be given, inasmuch as they seem to be representatives of a stage of volcanic action in which the igneous forces are gradually losing their energy. According to Daubeny, the volcanic action in these islands seems to be developed along two lines, nearly at right angles to each other, one parallel to that of the Apennines, beginning with Stromboli, intersecting Panaria, Lipari, and Vulcano; the other extending from Panaria to Salina, Alicudi, and Felicudi, and again visible in the volcanic products which make their appearance at Ustica. (See Map, Fig. 11.) The islands lie between the north coast of Sicily and that of Italy, and from their position seem to connect Etna with Vesuvius; but this is very problematical, as would appear from the difference of their lavas. The principal islands are those of Stromboli, Panaria, Lipari, Vulcano, Salina, Felicudi, and Alicudi. These three last are extinct or dormant, but Salina contains a crater, rising, according to Daubeny, not less than 3500 feet above the sea.[1] Vulcano (referred to by Strabo under the name of Hiera) consists of a crater which constantly emits large quantities of sulphurous vapours, but was in a state of activity in the year 1786, when, after frequent earthquake shocks and subterranean noises, it vomited forth during fifteen days showers of sand, together with clouds of smoke and flame, altering materially the shape of the crater from which they proceeded.

[Illustration: LIPARI ISLANDS.

Fig. 11.--Map to show the position of these islands, showing the branching lines of volcanic action--one parallel to that of the Apennines, the other stretching westwards at right angles thereto.]

The islands of Lipari are formed of beds of tuff, penetrated by numerous dykes of lava, from which uprise two or three craters, formed of pumice and obsidian passing into trachyte. Volcanic operations might have here been said to be extinct, were it not that their continuance is manifested by the existence of hot springs and "stufes," or vapour baths, at St. Calogero, about four miles from the town of Lipari. Daubeny considers it not improbable that this island may have had an active volcano even within the historical period, a view which is borne out by the statement of Strabo.[2]

[Illustration: Fig. 12.--Island of Vulcano, one of the Lipari Group, in eruption.--(After Sir W. Hamilton.)]

(_b._) But by far the most remarkable island of the group, as regards its present volcanic condition, is Stromboli, which has ever been in active eruption from the commencement of history down to the present day. Professor Judd, who visited this island in 1874, and has produced a striking representation of its aspect,[3] gives an account of which I shall here avail myself.[4] The island is of rudely circular outline, and rises into a cone, the summit of which is 3090 feet above the level of the Mediterranean. From a point on the side of the mountain masses of vapour are seen to issue, and these unite to form a cloud over the summit; the outline of this vapour-cloud varying continually according to the hygrometric state of the atmosphere, and the direction and force of the wind. At the time of Professor Judd's visit, the vapour-cloud was spread in a great horizontal stratum overshadowing the whole island; but it was clearly seen to be made up of a number of globular masses, each of which is a product of a distinct outburst of volcanic forces. Viewed at night-time, Stromboli presents a far more striking and singular spectacle. When watched from the deck of a vessel, a glow of red light is seen to make its appearance from time to time above the summit of the mountain; it may be observed to increase gradually in intensity, and then as gradually to die away. After a short interval the same appearances are repeated, and this goes on till the increasing light of dawn causes the phenomenon to be no longer visible. The resemblance presented by Stromboli to a "flashing light" on a most gigantic scale is very striking, and the mountain has long been known as "the lighthouse of the Mediterranean."

The mountain is built up of ashes, slag, and scorïæ, to a height of (as already stated) over 3000 feet above the surface of the sea; but, as Professor Judd observes, this by no means gives a just idea of its vast bulk. Soundings in the sea surrounding the island show that the bottom gradually shelves around the shores to a depth of nearly 600 fathoms, so that Stromboli is a great conical mass of cinders and slaggy materials, having a height above its floor of about 6600 feet, and a base the diameter of which exceeds four miles.

The crater of Stromboli is situated, not at the apex of the cone, but at a distance of 1000 feet below it. The explosions of steam, accompanied by the roaring as of a smelting furnace, or of a railway engine when blowing off its steam, are said by Judd to take place at very irregular intervals of time, "varying from less than one minute to twenty minutes, or even more." On the other hand, Hoffmann describes them as occurring at "perfectly regular intervals," so that, perhaps, some variation has taken place within the interval of about forty years between each observation. Both observers agree in stating that lava is to be seen welling up from some of the apertures within the crater, and pouring down the slope towards the sea, which it seldom or never reaches.[5] The

intermittent character of these eruptions appears to be due, as Mr. Scrope has suggested, to the exact proportion between the expansive and repressive forces; the expansive force arising from the generation of a certain amount of aqueous vapour and of elastic gas; the repressive, from the pressure of the atmosphere and from the weight of the superincumbent volcanic products. Steam is here, as in a steam-engine, not the originating agent in the phenomena recorded; but the result of water coming in contact with molten lava constantly welling up from the interior, by which it is converted into steam, which from time to time acquires sufficient elastic force to produce the eruptions; the water being obviously derived from the surrounding sea, which finds its way by filtration through fissures, or through the porous mass of which the mountain is formed. Were it not for the access of water this volcano would probably appear as a fissure-cone extruding a small and continuous stream of molten lava. The adventitious access of the sea water gives rise to the phenomena of intermittent explosions. The vitality of the volcano is therefore due, not to the presence of water, but to the welling up of matter from the internal reservoir through the throat of the volcano.

Pantelleria.—This island, lying between the coast of Sicily and Cape Bon in Africa, is wholly volcanic. It has a circumference of thirty miles, and from its centre rises an extinct crater-cone to a height of about 3000 feet. The flanks of this volcano are diversified by several fresh craters and lava-streams, while hot springs burst out with a hissing noise on its southern flank, showing that molten matter lies below at no very great depth.

This island probably lies along the dividing line between the non-volcanic and volcanic region of the Mediterranean, and is consequently liable to intermittent eruptions. It was at a short distance from this island that the remarkable submarine outburst of volcanic forces took place on October 17th, 1891, for an account of which we are indebted to Colonel J. C. Mackowen.[6] On that day, after a succession of earthquake shocks, the inhabitants were startled by observing a column of "smoke" rising out of the sea at a distance of three miles, in a north-westerly direction. The Governor, Francesco Valenza, having manned a boat, rowed out towards the fiery column, and on arriving found it to consist of black scoriaceous bombs, which were being hurled into the air to a height of nearly thirty yards; some of them burst in the air, others, discharging steam, ran hissing over the water; many of them were very hot, some even red-hot. One of these bombs, measuring two feet in diameter, was captured and brought to shore. It was observed that after the eruption the earthquake shocks ceased. A vast amount of material was cast out of the submarine crater, forming an island 500 yards in length and rising up to nine feet above

the surface, but after a few days it was broken up and dispersed over the sea-bed by the action of the waves.

[1] _Volcanoes_, p. 262. These islands are described by Hoffmann, _Poggendorf Annal._, vol. xxvi. (1832); also by Lyell, _Principles of Geology_, vol. ii., and by Judd, who personally visited them, and gives a very vivid account of their appearance and structure.

[2] Strabo, lib. vi.

[3] Judd, _Volcanoes_, p. 8.

[4] Stromboli has also been described by Spallanzani, Hoffmann, Daubeny, and others. The account of Judd is the most recent. Of this island Strabo says, "Strongyle a rotundate figuræ sic dicta, ignita ipsa quoque, violentia flammæ minor, fulgore excellens; ibi habitasse Æcolum ajunt."--Lib. vi.

[5] _Poggend. Annal._, vol. xxvi., quoted by Daubeny.

[6] Communicated by Captain Petrie to the Victoria Institute, 1st February 1892. See also a detailed and illustrated account of the eruption communicated by A. Ricco to the _Annali dell' Ufficio centrale Meteorologico e Geodinamico_, Ser. ii., Parte 3, vol. xi. Summarised by Mr. Butler in _Nature_, April 21, 1892.

THE TIME OF ROSES

IT was not in the winter
Our loving lot was cast;
It was the time of roses,—
We plucked them as we passed.

That churlish season never frowned
On earthly lovers yet:
Oh, no! the world was newly crowned
With flowers when first we met!

'Twas twilight, and I bade you go,
But still you held me fast;
It was the time of roses,—
We plucked them as we passed.

What else could peer thy glowing cheek,
That tears began to stud?
And when I asked the like of Love,
You snatched a damask bud;

And oped it to the dainty core,
Still glowing to the last.
It was the time of roses,—
We plucked them as we passed.
Thomas Hood.

ROSES.

from *The Complete Herbal*, by Nicholas Culpeper

EBook #49513

[Compiler's note: Don't Try This At Home -- this is ancient
& potentially dangerous medicine!]

I hold it altogether needless to trouble the reader with a description of any of these, since both the garden Roses, and the Roses of the briars are well enough known: take therefore the virtues of them as follows; And first I shall begin with the garden kinds.

Government and virtues.] What a pother have authors made with Roses! What a racket have they kept? I shall add, red Roses are under Jupiter, Damask under Venus, White under the Moon, and Provence under the King of France. The white and red Roses are cooling and drying, and yet the white is taken to exceed the red in both the properties, but is seldom used inwardly in any medicine: The bitterness in the Roses when they are fresh, especially the juice, purges choler, and watery humours; but being dried, and that heat which caused the bitterness being consumed, they have then a binding and astringent quality: Those also that are not full blown, do both cool and bind more than those that are full blown, and the white Rose more than the Red. The decoction of red Roses made with wine and used, is very good for the head-ache, and pains in the eyes, ears, throat, and gums; as also for the fundament, the lower part of the belly and the matrix, being bathed or put into them. The same decoction with the Roses remaining in it, is profitably applied to the region of the heart to ease the inflammation therein; as also St. Anthony's fire, and other diseases of the stomach. Being dried and beaten to powder, and taken in steeled wine or water, it helps to stay women's courses. The yellow threads in the middle of the Roses (which are erroneously called the Rose Seed) being powdered and drank in the distilled water of Quinces, stays the overflowing of women's courses, and doth wonderfully stay the defluations of rheum upon the gums and teeth, preserving them from corruption, and fastening them if they be loose, being washed and gargled therewith, and some vinegar of Squills added thereto. The heads with the seed being used in powder, or in a decoction, stays the lask and spitting of blood. Red Roses do strengthen the heart, the stomach and the liver, and the retentive faculty: They mitigate the pains that arise from heat, assuage inflammations, procure rest and sleep, stay both whites and reds in women, the gonorrhea, or running of the reins, and fluxes of the belly: the juice of them doth purge and cleanse the body from choler and phlegm. The husks of the Roses, with the beards and nails of the Roses, are binding and cooling, and the distilled water of either of them is good for the heat and redness in the eyes, and to

stay and dry up the rheums and watering of them. Of the Red Roses are usually made many compositions, all serving to sundry good uses, viz. Electuary of Roses, Conserve, both moist and dry, which is more usually called Sugar of roses, Syrup of dry Roses, and Honey of Roses. The cordial powder called *_Diarrhoden Abbatis_*, and *_Aromatica Rosarum_*. The distilled Water of Roses, Vinegar of Roses, Ointment, and Oil of Roses, and the Rose leaves dried, are of great use and effect. To write at large of every one of these, would make my book smell too big, it being sufficient for a volume of itself, to speak fully of them. But briefly, the Electuary is purging, whereof two or three drams taken by itself in some convenient liquor, is a purge sufficient for a weak constitution, but may be increased to six drams, according to the strength of the patient. It purges choler without trouble, it is good in hot fevers, and pains of the head arising from hot cholerick humours, and heat in the eyes, the jaundice also, and joint-aches proceeding of hot humours. The moist Conserve is of much use, both binding and cordial; for until it be about two years old, it is more binding than cordial, and after that, more cordial than binding. Some of the younger Conserve taken with mithridate mixed together, is good for those that are troubled with distillations of rheum from the brain to the nose, and defluxions of rheum into the eyes; as also for fluxes and lasks of the belly; and being mixed with the powder of mastich, is very good for the gonorrhea, and for the looseness of the humours in the body. The old Conserve mixed with *Aromaticum Rosarum*, is a very good cordial against faintings, swoonings, weakness, and tremblings of the heart, strengthens, both it and a weak stomach, helps digestion, stays casting, and is a very good preservative in the time of infection. The dry Conserve, which is called the Sugar of Roses, is a very good cordial to strengthen the heart and spirits; as also to stay defluxions. The syrup of dried red Roses strengthens a stomach given to casting, cools an over-heated liver, and the blood in agues, comforts the heart, and resists putrefaction and infection, and helps to stay lasks and fluxes. Honey of Roses is much used in gargles and lotions to wash sores, either in the mouth, throat, or other parts, both to cleanse and heal them, and to stay the fluxes of humours falling upon them. It is also used in clysters both to cool and cleanse. The cordial powders, called *Diarrhoden Abbatis* and *Aromaticum Rosarum*, do comfort and strengthen the heart and stomach, procure an appetite, help digestion, stay vomiting, and are very good for those that have slippery bowels, to strengthen them, and to dry up their moisture. Red Rose-water is well known, and of familiar use on all occasions, and better than Damask Rose-water, being cooling and cordial, refreshing, quickening the weak and faint spirits, used either in meats or broths, to wash the temples, to smell at the nose, or to smell the sweet vapours thereof out of a perfuming pot, or cast into a hot fire shovel. It is also of much good use against the redness

and inflammations of the eyes to bathe them therewith, and the temples of the head; as also against pain and ache, for which purpose also Vinegar of Roses is of much good use, and to procure rest and sleep, if some thereof, and Rose-water together, be used to smell unto, or the nose and temples moistened therewith, but more usually to moisten a piece of a red Rose-cake, cut for the purpose, and heated between a double folded cloth, with a little beaten nutmeg, and poppy-seed strewed on the side that must lie next to the forehead and temples, and bound so thereto all night. The ointment of Roses is much used against heat and inflammations in the head, to anoint the forehead and temples, and being mixt with *_Unguentum Populneum_*, to procure rest: it is also used for the heat of the liver, the back and reins, and to cool and heal pushes, wheals, and other red pimples rising in the face or other parts. Oil of Roses is not only used by itself to cool any hot swellings or inflammations, and to bind and stay fluxes of humours unto sores, but is also put into ointments and plaisters that are cooling and binding, and restraining the flux of humours. The dried leaves of the red Roses are used both inwardly and outwardly, both cooling, binding, and cordial, for with them are made both *_Aromaticum_*, *_Rosarum_*, *_Diarrhoden Abbatis_*, and *_Saccharum Rosarum_*, each of whose properties are before declared. Rose leaves and mint, heated and applied outwardly to the stomach, stays castings, and very much strengthen a weak stomach; and applied as a fomentation to the region of the liver and heart, do much cool and temper them, and also serve instead of a Rose-cake (as is said before) to quiet the over-hot spirits, and cause rest and sleep. The syrup of Damask Roses is both simple and compound, and made with Agaric. The simple solutive syrup is a familiar, safe, gentle and easy medicine, purging choler, taken from one ounce to three or four, yet this is remarkable herein, that the distilled water of this syrup should notably bind the belly. The syrup with Agaric is more strong and effectual, for one ounce thereof by itself will open the body more than the other, and works as much on phlegm as choler. The compound syrup is more forcible in working on melancholic humours; and available against the leprosy, itch, tetters, &c. and the French disease: Also honey of Roses solutive is made of the same infusions that the syrup is made of, and therefore works the same effect, both opening and purging, but is oftener given to phlegmatic than choleric persons, and is more used in clysters than in potions, as the syrup made with sugar is. The conserve and preserved leaves of those Roses are also operative in gently opening the belly.

The simple water of Damask Roses is chiefly used for fumes to sweeten things, as the dried leaves thereof to make sweet powders, and fill sweet bags; and little use they are put to in physic, although they have some purging quality; the wild Roses also are few or none of them used in physic, but are generally held to come near the nature of the

manured Roses. The fruit of the wild briar, which are called Hips, being thoroughly ripe, and made into a conserve with sugar, besides the pleasantness of the taste, doth gently bind the belly, and stay defluations from the head upon the stomach, drying up the moisture thereof, and helps digestion. The pulp of the hips dried into a hard consistence, like to the juice of the liquorice, or so dried that it may be made into powder and taken into drink, stays speedily the whites in women. The briar ball is often used, being made into powder and drank, to break the stone, to provoke urine when it is stopped, and to ease and help the cholic; some appoint it to be burnt, and then taken for the same purpose. In the middle of the balls are often found certain white worms, which being dried and made into powder, and some of it drank, is found by experience of many to kill and drive forth the worms of the belly.

THE CRAB SPIDER THAT LURKS AROUND THE NECTARIES OF FLOWERS

(*Xysticus gulosus*., Keys.)

From *Book of Monsters*, by David Fairchild and Marian Hubbard (Bell) Fairchild
Project Gutenberg EBook #40035

Like the beasts of prey which lurk around the water holes of African deserts, waiting for the feeble game to come down to drink, the crab spiders conceal themselves around the nectar-bearing discs of flowers. These nectar cups are the feeding places of thousands of sucking creatures, and the tragedies which take place in the shadows of the rose or lily petals are things we do not like to think of, for they are quite as real, quite as horrible and bloody struggles as those upon a larger scale, the very thought of which makes our blood run cold.

The crab spiders cannot run forward but dart sidewise and backward at great speed. One cannot help wondering if this ability may not often be an advantage rather than a drawback and enable the creature to surprise its prey by turning its back on it, something as a left-handed man often surprises an antagonist.

That these spiders run their own grave risks in this life around the nectar "water holes" is evident, for they form a large proportion of the food of mud wasps and if you want a handful of them, tear down a few mud daubers' nests sometime in June and empty out their contents. The brilliant colors will surprise you and suggest that possibly the yellow ones haunt the yellow flowers and the blue the blue ones.

The particular species whose low, sprawling form is shown in the photograph is one of forty occurring in the United States and, although it is only from a fourth to a third of an inch long, is considered one of the large species. It is dull-colored, and, unlike its gaily-colored relatives, awaits its prey under bark and stones.

It spins no web and the small male leads a thoroughly vagabond life, whereas the female, in most species at least, settles down toward the end of her life and, after depositing her silken lens-shaped sac of eggs in some protected spot, she lingers near as if to guard it till she dies.

BIRD LIFE IN WINTER

from *The Land's End*, by W. H. Hudson

EBook #47990

Land birds--Gulls in bad weather--Jackdaw and donkeys--Birds in the field--Yellowhammers--A miracle of the sun--The common sparrow--An old disused tin-mine--Sparrows roosting in a pit--Magpies' language--Goldcrests in the furze bushes--The Cornish wren--The sad little Meadow Pipit.

A GOOD deal of space has already been given to the sea-birds of this coast, but the land-birds deserve a chapter too. I do not wish, however, to give an account or a list of all of them, but would rather follow Carew's example, and note only "such as minister some particular cause of remembrance." The reader who would have more than this must seek for it in one of those "hasty schedules or inventories of God's property made by some clerk"--the local ornithologies and lists of species in the Victorian and other histories and various other works. On this exposed, wind-beaten, treeless coast country one does not expect to find an abundant or varied bird life; nevertheless in this unpromising place and in winter I had altogether a very pleasant time with the feathered people.

When the weather was too bad for the cliffs the gulls were driven inland. Gannets and cormorants could endure it; the sea was their true home and abiding-place and they were not to be torn from it; but the vagrant, unsettled and somewhat unballasted gulls would not or could not stay, and were like froth of the breakers which is caught up and whirled inland by the blast. On such days (and they were many) the gulls were all over the land, wandering about in their usual aimless manner, or in flocks seen resting on the grass in the shelter of a stone wall, or mixing loosely with companies of daws, rooks, peewits and other skilful worm and grub hunters, waiting idly for the chance of snatching a morsel from a neighbour's beak.

I was a little like the gulls in my habits: on fine days the cliffs and cliff castles were my favourite haunts; in very rough weather my rambles were mostly away from the sea, where I had my old companions of the sea wall, the gulls and daws, still with me. So much has already been said of this last species in former chapters that I might appear to be giving him too great prominence to bring him in again. Yet I must do so just to relate a little scene I witnessed in which this bird had a principal part, the other characters being donkeys.

The donkey is almost the only domestic creature one meets with out

on the rough high moor and among the stony hills. Cows and horses are occasionally seen, but they do not strike one as native to the place as the donkey does. He is a sort of link between the homestead and the wilderness. The donkey is man's poor, patient, anciently-broken creature, but when he roams abroad in quest of that tough and juiceless fodder on the desolate heath and hillsides--a food thought good enough for the likes of him, or the likes of he, as his master would say--he fits into the scene as the cow and horse certainly do not. He is not so big, and his rough, dirty or dusty coat of dull indeterminate greys and earthy and heather-like browns makes him harmonise with his surroundings. His long-drawn reiterated droning and whistling cry strikes one, too, as a voice of the wild incult places. On this account I have a very friendly feeling for him, and was always pleased at meeting with donkeys in my solitary walks, which was often enough, as most persons keep one or more in these parts. He is a good servant, and costs nothing to keep. Frequently I turn aside to speak to them, and as a rule they turn their backs or hinder parts on me, as much as to say that they have enough of human beings in the village: here they prefer to be left alone. But when I produce an apple from my pocket they at once think better of it, and gather round me very much interested in the apple, and quite willing for the sake of the apple to let me rub their noses and pull their ears.

One day, walking softly through a thicket of very high furze bushes, I came to a small green open space in which were three donkeys, one lying stretched out full length on the bed of moss with a jackdaw sitting on his ribs busily searching for ticks or parasites of some kind and picking them from his skin. The other two donkeys were standing by, gazing at the busy bird and probably envying their comrade his good luck. My sudden appearance at a distance of two or three yards greatly alarmed them. Away flew the daw, and up jumped the recumbent donkey, and then all three stared at me, not at all pleased at the intrusion.

It seemed to me on this occasion that in the daw, the friend and helper of our poor slave the donkey, the bird that in its corvine intelligence and cunning approaches nearest to ourselves among the avians, we have yet another link uniting man to his wild fellow-creatures.

There is a good deal of rough weather but little frost in this district; behind the cliffs, sheltered by stone hedges and thickets of furze, the green field is the chief feeding-ground of the birds; there with the rooks and daws and gulls and peewits you find fieldfares--the bluebird of the natives--and missel-thrushes in flocks, and the greybird, as the song-thrush is called, the blackbird and small troops of wintering larks. Most abundant is the starling, a winter visitor too, for he does not breed in this part of Cornwall. You will find a flock in every

little field, and the sight of your head above the stone wall sends them off with a rush, emitting the low guttural alarm note which sounds like running water.

The yellowhammer is a common resident species here. We usually think him an uninteresting bird on account of his phlegmatic disposition and monotonous song, but in this district, in winter, I found him curiously attractive, and among the modestly-coloured birds that were his neighbours he was certainly the most splendid. That may appear a word better suited to the golden oriole, but I am thinking of one of his aspects, as I frequently saw him, and of a miracle of the sun. Here, in winter, he congregates in small companies or flocks at the farms, and at one small farm where there was a rather better shelter than at most of the others, owing to the way the houses and outhouses and ricks were grouped together, the company of wintering yellowhammers numbered about eighty or ninety. Every evening, when there was any sun, these birds would gather on some spot--a rick or barn roof or on the dark green bushes--sheltered from the sea wind, where they could catch the last rays. Sitting motionless grouped together in such numbers they made a strangely pretty picture.

One evening, at another farm-house, I was standing out of doors talking with the farmer, when the sun came out beneath a bank of dark cloud and shone level on the slate roof of a cow-house near us. It was an old roof on which the oxidised slate had taken a soft blue-grey or dove colour--the one beautiful colour ever seen in weathered slate; and no sooner had the light fallen on it than a number of yellow-hammers flew from some other point where they had been sitting and dropped down upon this roof. They were scattered over the slates, and, sitting motionless with heads drawn in and plumage bunched out, they were like golden images of birds, as if the sun had poured a golden-coloured light into their loose feathers to make them shine.

The grey wagtail and the goldfinch, in small numbers, both beautiful birds, were wintering here, but they could not compare with those transfigured yellowhammers I had seen.

As for the vulgar sparrow, nothing--not even the miracle-working sun--could make him brilliant or beautiful to look at, and I have indeed acquired the habit of not looking and not seeing the undesired thing. That is, in the country: in London it is different; there I can be thankful for the sparrow where he does us (and the better birds) no harm and lives very comfortably on the crumbs that fall from our tables. Yet now, at one spot on this coast, I was surprised into paying particular attention to the sparrows on account of a winter custom they had

acquired.

One day on very rough land, half a mile from the cliff, I came on a piece of ground of about two acres in extent surrounded by a big stone hedge, without gap or gate. It was the site of an old tin-mine abandoned fifty or sixty years ago and walled round to prevent the domestic animals from the neighbouring farms falling into the pits. It was strange that so much trouble had been taken for such an object, as in all the other disused mining pits I had come upon in the district the holes had simply been covered over with wood and big stones, or they remained open and the cattle were left to take their chance. The stone hedge was covered with a thick growth of furze, and the ground inside, protected as it was from the cattle and sheltered by the wall from the furious winds, had become a dense and in places impenetrable thicket of blackthorn, bramble, furze and ivy. So close did the blackthorn bushes grow with their upper branches tightly interwoven that it would have been possible to walk on the top of the thicket at a height of twelve or fourteen feet from the ground without the foot slipping through. There were three pits, and one, very much enlarged owing to the quantity of earth which had fallen in, was entirely occupied with a big elder bush, or tree--a curiosity in this treeless district. It was rooted in the side of the pit about fourteen feet below the surface, and its whole height was about thirty feet. Near the root the trunk divided into three great branches, or boles, and on the middle one there was an old magpie's nest on a level with my shoulders and a little beyond the reach of my hand. The birds were perhaps wise to build in such a place, since a boy could not easily rob it without danger of falling into the pit.

On going to this walled-in thicket one evening I observed a vast concourse of sparrows. They were sitting on the bushes in thousands, and more birds in small companies of a dozen or so, and in small flocks of fifty to a hundred, were continually arriving and settling down among the others to add their voices to the extraordinary hubbub they kept up. It was like a starling's winter roosting-place, and the birds must have come from all the homesteads on either side for a good many miles. These birds, I found, roosted in the old pits, and when they had all disappeared from sight and the loud noise of chirruping had died into silence I walked up to one of the pits and stood over it. The birds took alarm and began to issue out, coming up in rushes of several hundreds at a time, rush succeeding rush at intervals of a few seconds while I stood by, but when I retired to some distance the birds would come up in a continuous stream which sometimes looked in the fading light like a column of smoke rising from the ground.

Three months later, when the sparrows were breeding and spending their nights at home, I revisited the spot, and going to the pit with the

elder tree growing in it had a fresh look at the old magpie nest. And there was Mag herself, sitting on her pretty eggs under her roof of thorny sticks! After suffering my presence for about two minutes she slipped off and went away without a sound. Wishing her good luck I came away, as I did not want to make her unhappy by too long a visit.

The magpie is extremely common in these parts although there are no trees for them to breed in. You meet with him twenty times a day when out walking. He flies up a distance ahead, rising vertically, and hovers a moment to get a good look at you, then hastens away on rapidly-beating wings and slopes off into the furze bushes, displaying his open graduated tail. He haunts the homestead and is frequently to be seen associating with the poultry; there are no pheasants here and no gamekeepers to shoot him, and, as in Ireland, the people do not like to injure though they do not love him.

If you chance to hear a bird note or phrase that is new to you in this place you may be sure the magpie is its author. Like the jay he is an inventor of new sounds and has a somewhat different language for every part of the country. The loud brisk chatter, his alarm note, which resembles the tremulous bleat of a goat, is always the same; but his ordinary language, used in conversation, when he is with his mate or a small party of friends, is curiously varied and full of surprises. It was one of my amusements in genial days in winter when a confabulation was in progress to steal as near as I could and sit down among the bushes to listen.

On one such occasion, where the furze was very thick and high, I discovered that the bushes all round me teemed with minute, shadowy-looking bird-forms silently hopping and flitting about. They were golden-crested wrens wintering in this treeless place in considerable numbers. Some of the small boys I talked to in this neighbourhood knew the bird as the "Golden Christian Wrennie"--a rather pretty variant.

But the Golden Christian Wrennie is not _the_ wren--not the Cornish wren; for there is a proper Cornish wren, even as there is a St. Kilda wren, and as there is a native wren, or local race or _Troglodytes parvulus_, in every county, in every village and farm-house and wood and coppice and hedge in the United Kingdom. He is a home-keeping little bird, and when you find him, summer or winter, in town or country, you know that he is a native, that his family is a very old one in that part and was probably settled there before the advent of blue-eyed man and the dawn of a Bronze Age.

He is universal, and that gives one the idea that he is very evenly

distributed; but I had no sooner set foot in this "westest" part of all England than I found the wren more common than in any other part of the country known to me, and this greatly pleased me because of my love of him. Indeed, it was the prevalence of the wren which made the West Cornwall bird life seem very much to me, despite the fact that the best species have been extirpated or driven away and that no peregrine or chough or hoopoe, or other distinguished feathered stranger, can return to these shores and not be instantly massacred by the sportsmen, ornithologists and private collectors. But the common little wren is admired and respected by every one, even by the philistines. It is not that he seeks to ingratiate himself with us like the robin; he is the very opposite of that friendly little creature, and indeed I like him as much for his independence as for his other sterling qualities. You may feed the birds every day in cold weather and have them gather in crowds to gobble up your scraps, but you will not find the wren among them. He doesn't want of your charity, and can get his own living in all seasons and in all places, rough or smooth, as you will find if you walk round the coast from St. Ives to Land's End or to Mount's Bay.

Not a furze clump, nor stone hedge, nor farm building, nor old ruined tin-mine, nor rocky headland, but has its wren, and go where you will in this half-desert silent place you hear at intervals his sharp strident note; but not to welcome you. Your heavy footsteps have disturbed and brought him out of his hiding-place to look at you and vehemently express his astonishment and disapproval. And having done so he vanishes back into seclusion and dismisses the fact of your existence from his busy practical little mind. He is at home, but not to you. 'Tis the only home he knows and he likes it very well, finding his food and roosting by night and rearing his young just in that place, with fox and adder and other deadly creatures for only neighbours. Such a mite of a bird with such small round feeble wings and no more blood in him than would serve to wet a weasel's whistle! Best of all it is to see him among the rude granite rocks of a headland, living in the roar of the sea: when the wind falls or a gleam of winter sunshine visits earth you will find him at a merry game of hide-and-seek with his mate among the crags, pausing from time to time in his chase to pour out that swift piercing lyric which you will hear a thousand times and never without surprise at its power and brilliance.

In these waste stony places, where the wren is common, another small feathered creature was with me just as often--the anxious, irresolute meadow pipit, or titlark, who is the very opposite in character to the brisk, vigorous, positive little brown bird whose mind is made up and who does everything straight off. Nevertheless he gave me almost as much pleasure, only it was a somewhat different feeling--a pleasure of a pensive kind with something of mystery in it. He did not sing, even on

those bright days or hours in January, which caused such silent ones as the corn bunting and pied wagtail to break out in melody. The bell-like tinkling strain he utters when soaring up and dropping to earth is for summer only: it is that faint fairy-like aerial music which you hear on wide moors and commons and lonely hillsides. In winter he has no language but that one sharp sorrowful little call, or complaint, the most anxious sound uttered by any small bird in these islands. It is a sound that suits the place, and when the wind blows hard, bringing the noise of the waves to your ears, and the salt spray; when all the sky is one grey cloud, and sea mists sweep over the earth at intervals blurring the outline of the hills, that thin but penetrative little sad call seems more appropriate than ever and in tune with Nature and the mind. The movements, too, of the unhappy little creature have a share in the impression he makes; he flings himself up, as it were, before your footsteps out of the brown heath, pale tall grasses and old dead bracken, and goes off as if blown away by the wind, then returns to you as if blown back, and hovers and goes to this side, then to that, now close to you, a little sombre bird, and anon in appearance a mere dead leaf or feather whirled away before the blast. During the uncertain flight, and when, at intervals, he drops upon a rock close by, he continues to emit the sharp sorrowful note, and if you listen it infects your mind with its sadness and mystery. You can imagine that the wind-blown feathered mite is not what it seems, a mere pipit, but a spirit of that place in the shape and with the voice of a mournful little bird—a spirit that cannot go away nor die, nor ever forget the unhappy things it witnessed in pity and terror long ages gone when an ancient people, or a fugitive remnant, gathered at this desolate end of all the land—a tragedy so old that it was forgotten on the earth and those who had part in it turned to dust thousands of years ago.

PALIMPSEST OF TWILIGHT

Darkness comes out of the earth
And swallows dip into the pallor of the west;
From the hay comes the clamour of children's
 mirth;
 Wanes the old palimpsest.

The night-stock oozes scent,
And a moon-blue moth goes flittering by:
All that the worldly day has meant
 Wastes like a lie.

The children have forsaken their play;
A single star in a veil of light
Glimmers: litter of day
 Is gone from sight.

by D. H. Lawrence, from *New Poems*
EBook #22726

THE DISCOVERY OF NEPTUNE

from *Astronomical Discovery*, by Herbert Hall Turner

EBook #33337

[Sidenote: Search for definite objects.]

In the last chapter we saw that the circumstances under which planets were discovered varied considerably. Sometimes the discoveries were not previously expected, occurring during a general examination of the heavens, or a search for other objects; and, on one occasion at least, the discovery may be said to have been even contrary to expectation, though, as the existence of a number of minor planets began to be realised, there have also been many cases where the discovery has been made as the result of a definite and deliberate search. But the search cannot be said to have been inspired by any very clear or certain principle: for the law of Bode, successful though it has been in indicating the possible existence of new planets, cannot, as yet, be said to be founded upon a formulated law of nature. We now come, however, to a discovery made in direct interpretation of Newton's great law of gravitation—the discovery of Neptune from its observed disturbance of Uranus. I will first briefly recall the main facts relating to the actual discovery.

[Sidenote: Disturbance of Uranus.]

After Uranus had been discovered and observed sufficiently long for its orbit to be calculated, it was found that the subsequent position of the planet did not always agree with this orbit; and, more serious than this, some early observations were found which could not be reconciled with the later ones at all. It is a wonderful testimony to the care and sagacity of Sir William Herschel, as was remarked in the last chapter, that Uranus was found to have been observed, under the mistaken impression that it was an ordinary star, by Flamsteed, Lemonnier, Bradley, and Mayer, all observers of considerable ability. Flamsteed's five observations dated as far back as 1690, 1712, and 1715; observations by others were in 1748, 1750, 1753, 1756, and so on up to 1771, and the body of testimony was so considerable that there was no room for doubt as to the irreconcilability of the observations with the orbit, such as might have been the case had there been only one or two, possibly affected with some errors.

[Sidenote: Suspicion of perturbing planet.]

It is difficult to mention an exact date for the conversion into certainty of the suspicion that no single orbit could be found to satisfy all the observations; but we may certainly regard this fact as established in 1821, when Alexis Bouvard published some tables of the planet, and showed fully in the introduction that when every correction for the disturbing

action of other planets had been applied, it was still impossible to reconcile the old observations with the orbit calculated from the new ones. The idea accordingly grew up that there might be some other body or bodies attracting the planet and causing these discrepancies. Here again it is not easy to say exactly when this notion arose, but it was certainly existent in 1834, as the following letter to the Astronomer Royal will show. I take it from his well-known "Account of some Circumstances historically connected with the Discovery of the Planet exterior to Uranus," which he gave to the Royal Astronomical Society at its first meeting after that famous discovery (Monthly Notices of the R.A.S., vol. iii., and Memoirs, vol. xvi.).

NO. 1.--_The_ REV. T. J. HUSSEY _to_ G. B. AIRY.
[_Extract._]

"HAYES, KENT, _17th November 1834_.

"With M. Alexis Bouvard I had some conversation upon a subject I had often meditated, which will probably interest you, and your opinion may determine mine. Having taken great pains last year with some observations of _Uranus_, I was led to examine closely Bouvard's tables of that planet. The apparently inexplicable discrepancies between the ancient and modern observations suggested to me the possibility of some disturbing body beyond _Uranus_, not taken into account because unknown. My first idea was to ascertain some approximate place of this supposed body empirically, and then with my large reflector set to work to examine all the minute stars thereabouts: but I found myself totally inadequate to the former part of the task. If I could have done it formerly, it was beyond me now, even supposing I had the time, which was not the case. I therefore relinquished the matter altogether; but subsequently, in conversation with Bouvard, I inquired if the above might not be the case: his answer was, that, as might have been expected, it had occurred to him, and some correspondence had taken place between Hansen and himself respecting it. Hansen's opinion was, that one disturbing body would not satisfy the phenomena; but that he conjectured there were two planets beyond _Uranus_. Upon my speaking of obtaining the places empirically, and then sweeping closely for the bodies, he fully acquiesced in the propriety of it, intimating that the previous calculations would be more laborious than difficult; that if he had leisure he would undertake them and transmit the results to me, as the basis of a very close and accurate sweep. I have not heard from him since on the subject, and have been too ill to write. What is your opinion on the subject? If you consider the idea as possible, can you give me the limits, roughly, between which this body or those bodies may probably be found during the ensuing winter? As we might

expect an eccentricity [inclination?] approaching rather to that of the old planets than of the new, the breadth of the zone to be examined will be comparatively inconsiderable. I may be wrong, but I am disposed to think that, such is the perfection of my equatoreal's object-glass, I could distinguish, almost at once, the difference of light of a small planet and a star. My plan of proceeding, however, would be very different: I should accurately map the whole space within the required limits, down to the minutest star I could discern; the interval of a single week would then enable me to ascertain any change. If the whole of this matter do not appear to you a chimæra, which, until my conversation with Bouvard, I was afraid it might, I shall be very glad of any sort of hint respecting it.'

"My answer was in the following terms:--

[Sidenote: Airy's scepticism.]

NO. 2.--G. B. AIRY _to the_ REV. T. J. HUSSEY.
[_Extract._]

"OBSERVATORY, CAMBRIDGE, _1834, Nov. 23_.

"I have often thought of the irregularity of _Uranus_, and since the receipt of your letter have looked more carefully to it. It is a puzzling subject, but I give it as my opinion, without hesitation, that it is not yet in such a state as to give the smallest hope of making out the nature of any external action on the planet ... if it were certain that there were any extraneous action, I doubt much the possibility of determining the place of a planet which produced it. I am sure it could not be done till the nature of the irregularity was well determined from several successive revolutions."

[Sidenote: Le Verrier's papers.]

[Sidenote: Planet to be detected by disc.]

[Sidenote: Galle's discovery of the planet.]

Although only a sentence or two have been selected from Airy's reply (he was not yet Astronomer Royal), they are sufficient to show that the problem of finding the place of such a possible disturbing body was regarded at that time as one of extreme difficulty; and no one appears seriously to have contemplated embarking upon its solution. It was not until many years later that the solution was attempted. Of the first

attempt we shall speak presently, putting it aside for the moment because it had no actual bearing on the discovery of the planet, for reasons which form an extraordinary episode of this history. The attempt which led to success dates from November 1845. The great French astronomer Le Verrier, on November 10, 1845, read to the French Academy a paper on the Orbit of Uranus, considering specially the disturbances produced by Jupiter and Saturn, and showing clearly that with no possible orbit could the observations be satisfied. On June 1, 1846, followed a second paper by the same author, in which he considers all the possible explanations of the discordance, and concludes that none is admissible except that of a disturbing planet exterior to Uranus. And assuming, in accordance with Bode's Law, that the distance of this new planet from the sun would be about double that of Uranus (and it is important to note this assumption), he proceeds to investigate the orbit of such a planet, and to calculate the place where it must be looked for in the heavens. This was followed by a third paper on August 31st, giving a rather complete discussion, and arriving at the conclusion that the planet should be recognisable from its disc. This again is an important point. We remember that in the discovery of Uranus it needed considerable skill on the part of Sir William Herschel to detect the disc, to see in fact any difference between it and surrounding stars; and that other observers, even when their attention had been called to the planet, found it difficult to see this difference. It might be expected, therefore, that with a planet twice as far away (as had been assumed for the new planet) the disc would be practically unrecognisable, and as we shall presently see, this assumption was made in some searches for the planet which had been commenced even before the publication of this third paper. Le Verrier's courageous announcement, which he deduced from a consideration of the mass of the planet, that the disc should be recognisable, led immediately to the discovery of the suspected body. He wrote to a German astronomer, Dr. Galle (still, I am glad to say, alive and well, though now a very old man), telling him the spot in the heavens to search, and stating that he might expect to detect the planet by its appearance in this way; and the same night Dr. Galle, by comparing a star map with the heavens, found the planet.

[Sidenote: Adams' work publicly announced.]

To two points to which I have specially called attention in this brief summary--namely, the preliminary assumption that the planet would be, according to Bode's Law, twice as far away as Uranus; secondly, the confident assertion that it would have a visible disc--I will ask you to add, thirdly, that it was found by the aid of a star map, for this map played an important part in the further history to which we shall now proceed. It may naturally be supposed that the announcement of the finding of a planet in this way, the calculation of its place from a belief in the

universal action of the great Law of Gravitation, the direction to an eminent observer to look in that place for a particular thing, and his immediate success,—this extraordinary combination of circumstances caused a profound sensation throughout not only the astronomical, but the whole world; and this sensation was greatly enhanced by the rumour which had begun to gather strength that, but for some unfortunate circumstances, the discovery might have been made even earlier and as a consequence of totally independent calculations made by a young Cambridge mathematician, J. C. Adams. Some of you are doubtless already familiar with the story in its abridged form, for it has been scattered broadcast through literature. In England it generally takes the form of emphasising the wickedness or laziness of the Astronomer Royal who, when told where to look for a planet, neglected his obvious duty, so that in consequence another astronomer who made the calculation much later and gave a more virtuous observer the same directions where to look, obtained for France the glory of a discovery which ought to have been retained in England. There is no doubt that Airy's conduct received a large amount of what he called "savage abuse." When the facts are clearly stated I think it will be evident that many of the harsh things said of him were scarcely just, though at the same time it is also difficult to understand his conduct at two or three points of the history, even as explained by himself.

[Sidenote: Facts undoubted.]

There is fortunately no doubt whatever about any of the _facts_. Airy himself gave a very clear and straightforward account of them at the time, for which more credit is due to him than he commonly receives; and since the death of the chief actors in this sensational drama they have been naturally again ransacked, with the satisfactory result that there is practically no doubt about any of the facts. As to the proper interpretations of them there certainly may be wide differences of opinion, nor does this circumstance detract from their interest. It is almost impossible to make a perfectly colourless recital of them, nor is it perhaps necessary to do so. I will therefore ask you to remember in what I now say that there is almost necessarily an element of personal bias, and that another writer would probably give a different colouring. Having said this, I hope I may speak quite freely as the matter appears in my personal estimation.

[Sidenote: Airy's "Account."]

[Sidenote: "A movement of the age."]

Airy's account was, as above stated, given to the Royal Astronomical Society at their first meeting (after the startling announcement of the discovery of the new planet), on November 13, 1846, and I have already

quoted an extract from it. He opens with a tribute to the sensational character of the discovery, and then states that although clearly due to two individuals (namely, Le Verrier and Galle), it might also be regarded as to some extent the consequence of a movement of the age. His actual words are these: "The principal steps in the theoretical investigations have been made by one individual, and the published discovery of the planet was necessarily made by one individual. To these persons the public attention has been principally directed; and well do they deserve the honours which they have received, and which they will continue to receive. Yet we should do wrong if we considered that these two persons alone are to be regarded as the authors of the discovery of this planet. I am confident that it will be found that the discovery is a consequence of what may properly be called a movement of the age; that it has been urged by the feeling of the scientific world in general, and has been nearly perfected by the collateral, but independent labours, of various persons possessing the talents or powers best suited to the different parts of the researches."

[Sidenote: Airy under-estimated Adams' work.]

I have quoted these words as the first point at which it is difficult to understand Airy's conduct in excluding from them all specific mention of Adams, knowing as he did the special claims which entitled him to such mention; claims indeed which he proceeded immediately to make clear. It seems almost certain that Airy entirely under-estimated the value of Adams' work throughout. But this will become clearer as we proceed. The "account" takes the form of the publication of a series of letters with occasional comments. Airy was a most methodical person, and filed all his correspondence with great regularity. It was jestingly said of him once that if he wiped his pen on a piece of blotting-paper, he would date the blotting-paper and file it for reference. The letters reproduced in this "account" are still in the Observatory at Greenwich, pinned together just as Airy left them; and in preparing his "account" it was necessary to do little else than to have them copied out and interpolate comments. From two of them I have already quoted to show how difficult the enterprise of finding an exterior planet from its action on Uranus was considered in 1834. To these may be added the following sentence from No. 4, dated 1837. "If it be the effect of any unseen body," writes Airy to Bouvard, "it will be nearly impossible ever to find out its place." But the first letter which need concern us is No. 6, and it is only necessary to explain that Professor Challis was the Professor of Astronomy at Cambridge, and in charge of the Cambridge Observatory, in which offices he had succeeded Airy himself on his leaving Cambridge for Greenwich some eight years earlier.

No. 6.--PROFESSOR CHALLIS _to_ G. B. AIRY.

[_Extract._]

"CAMBRIDGE OBSERVATORY, _Feb. 13, 1844_.

[Sidenote: Challis mentions Adams to Airy, and suggests Adams' visit to Greenwich.]

"A young friend of mine, Mr. Adams of St. John's College, is working at the theory of _Uranus_, and is desirous of obtaining errors of the tabular geocentric longitudes of this planet, when near opposition, in the years 1818-1826, with the factors for reducing them to errors of heliocentric longitude. Are your reductions of the planetary observations so far advanced that you could furnish these data? and is the request one which you have any objection to comply with? If Mr. Adams may be favoured in this respect, he is further desirous of knowing, whether in the calculation of the tabular errors any alterations have been made in Bouvard's _Tables of Uranus_ besides that of _Jupiter's_ mass.'

"My answer to him was as follows:--

No. 7.--G. B. AIRY _to_ PROFESSOR CHALLIS.

[_Extract._]

"ROYAL OBSERVATORY, GREENWICH, _1844, Feb. 15_.

"I send all the results of the observations of _Uranus_ made with both instruments (that is, the heliocentric errors of _Uranus_ in longitude and latitude from 1754 to 1830, for all those days on which there were observations, both of right ascension and of polar distance). No alteration is made in Bouvard's _Tables of Uranus_ except in increasing the two equations which depend on _Jupiter_ by 1/50 part. As constants have been added (in the printed tables) to make the equations positive, and as 1/50 part of the numbers in the tables has been added, 1/50 part of the constants has been subtracted from the final results.'

"Professor Challis in acknowledging the receipt of these, used the following expressions:--

No. 8.--PROFESSOR CHALLIS _to_ G. B. AIRY.

[_Extract._]

"CAMBRIDGE OBSERVATORY, _Feb. 16, 1844_.

"I am exceedingly obliged by your sending so complete a series of tabular errors of _Uranus_.... The list you have sent will give Mr. Adams the means of carrying on in the most effective manner the inquiry in which he is engaged.'

"The next letter shows that Mr. Adams has derived results from these errors.

No. 9.--PROFESSOR CHALLIS _to_ G. B. AIRY.

"CAMBRIDGE OBSERVATORY, _Sept. 22, 1845_.

"My friend Mr. Adams (who will probably deliver this note to you) has completed his calculations respecting the perturbation of the orbit of _Uranus_ by a supposed ulterior planet, and has arrived at results which he would be glad to communicate to you personally, if you could spare him a few moments of your valuable time. His calculations are founded on the observations you were so good as to furnish him with some time ago; and from his character as a mathematician, and his practice in calculation, I should consider the deductions from his premises to be made in a trustworthy manner. If he should not have the good fortune to see you at Greenwich, he hopes to be allowed to write to you on this subject.'

"On the day on which this letter was dated, I was present at a meeting of the French Institute. I acknowledged it by the following letter:--

NO. 10.--G. B. AIRY _to_ PROFESSOR CHALLIS.

"ROYAL OBSERVATORY, GREENWICH, _1845, Sept. 29_.

"I was, I suppose, on my way from France, when Mr. Adams called here; at all events, I had not reached home, and therefore, to my regret, I have not seen him. Would you mention to Mr. Adams that I am very much interested with the subject of his investigations, and that I should be delighted to hear of them by letter from him?'

"On one of the last days of October 1845, Mr. Adams called at the Royal Observatory, Greenwich, in my absence and left the following important paper:--

No. 11.--J. C. ADAMS, Esq., _to_ G. B. AIRY.

[Sidenote: Adams' announcement of the new planet.]

"According to my calculations, the observed irregularities in the motion of _Uranus_ may be accounted for by supposing the existence of an exterior planet, the mass and orbit of which are as follows:--

Mean distance (assumed nearly in accordance with Bode's Law)	38.4
Mean sidereal motion in 365.25 days	1°30'.9
Mean longitude, 1st October 1845	323 34
Longitude of perihelion	315 55
Eccentricity	0.1610.
Mass (that of the sun being unity)	0.0001656.

For the modern observations I have used the method of normal places, taking the mean of the tabular errors, as given by observations near three consecutive oppositions, to correspond with the mean of the times; and the Greenwich observations have been used down to 1830: since which, the Cambridge and Greenwich observations, and those given in the _Astronomische Nachrichten_, have been made use of. The following are the remaining errors of mean longitude:--

Observation--Theory.

"
1780 +0.27
1783 -0.23
1786 -0.96
1789 +1.82
1792 -0.91
1795 +0.09
1798 -0.99
1801 -0.04
1804 +1.76
1807 -0.21
1810 +0.56
1813 -0.94
1816 -0.31
1819 -2.00
1822 +0.30
1825 +1.92
1828 +2.25
1831 -1.06
1834 -1.44

1837 -1.62
1840 +1.73

The error for 1780 is concluded from that for 1781 given by observation, compared with those of four or five following years, and also with Lemonnier's observations in 1769 and 1771.

"For the ancient observations, the following are the remaining errors:--

Observation--Theory.

"
1690 +44.4
1712 + 6.7
1715 - 6.8
1750 - 1.6
1753 + 5.7
1756 - 4.0
1763 - 5.1
1769 + 0.6
1771 +11.8

The errors are small, except for Flamsteed's observation of 1690. This being an isolated observation, very distant from the rest, I thought it best not to use it in forming the equations of condition. It is not improbable, however, that this error might be destroyed by a small change in the assumed mean motion of the planet.'

"I acknowledged the receipt of this paper in the following terms:--

NO. 12.--G. B. AIRY _to_ J. C. ADAMS, Esq.

"ROYAL OBSERVATORY, GREENWICH, _1845, Nov. 5_.

[Sidenote: Airy's inquiry about the "radius vector."]

"I am very much obliged by the paper of results which you left here a few days since, showing the perturbations on the place of _Uranus_ produced by a planet with certain assumed elements. The latter numbers are all extremely satisfactory: I am not enough acquainted with Flamsteed's observations about 1690 to say whether they bear such an error, but I think it extremely probable.

"But I should be very glad to know whether this assumed perturbation

will explain the error of the radius vector of _Uranus_. This error is now very considerable, as you will be able to ascertain by comparing the normal equations, given in the Greenwich observations for each year, for the times _before_ opposition with the times _after_ opposition.'

"I have before stated that I considered the establishment of this error of the radius vector of _Uranus_ to be a very important determination. I therefore considered that the trial, whether the error of radius vector would be explained by the same theory which explained the error of longitude, would be truly an _experimentum crucis_. And I waited with much anxiety for Mr. Adams' answer to my query. Had it been in the affirmative, I should at once have exerted all the influence which I might possess, either directly, or indirectly through my friend Professor Challis, to procure the publication of Mr. Adams' theory.

"From some cause with which I am unacquainted, probably an accidental one, I received no immediate answer to this inquiry. I regret this deeply, for many reasons."

[Sidenote: Adams' silence.]

Here we may leave Airy's "account" for a few moments to consider the reason why he received no answer. Adams was a very shy and retiring young man, and very sensitive; though capable of a great resolution, and of enormous perseverance in carrying it out. We know (what is not indicated in the above account), how steadily he had kept in view the idea of solving this great problem. It was characteristic of him that as early as 1841 he had formed a resolution to undertake it, although at the time he was not able to enter upon its accomplishment. The following memorandum, which is still in existence, having been found among his papers after his death, records these facts:

"1841, July 3. Formed a design, in the beginning of this week, of investigating, as soon as possible after taking my degree, the irregularities in the motion of Uranus, which were as yet unaccounted for: in order to find whether they may be attributed to the action of an undiscovered planet beyond it, and if possible thence to determine the elements of its orbit, &c., approximately, which would probably lead to its discovery."

Accordingly, "as soon as possible after taking his degree" he embarked upon the enterprise, and the first solution was made in the long vacation of 1843, assuming the orbit of the unknown planet to be a circle with a radius equal to twice the mean distance of Uranus from the sun (an

assumption which, as we have seen, was also made by Le Verrier). Having satisfied himself that there was a good general agreement between his results and the observations, Adams began a more complete solution; indeed from first to last he made no less than six separate solutions, the one which he announced to Airy in the above letter being the fourth. Hence he had already done an enormous amount of work on the problem, and was in his own mind so justly convinced of the correctness and value of his results that he was liable to forget that others had not had the same opportunity of judging of their completeness; and he was grievously disappointed when his announcement was not received with full confidence.

[Sidenote: His disappointment at Greenwich, and at Airy's question.]

But perhaps it should first be stated that by a series of mischances Adams had been already much disappointed at the failure of his attempts to see the Astronomer Royal on his visits to Greenwich. This does not seem to have been exactly Airy's fault; he was, as may well be supposed, an extremely busy man, and was much occupied at the time on a question of great practical importance, at the direct request of the Government, namely, the settling of the proper gauge for railways throughout the country. The first time Adams called to see him, he was actually in London sitting on the Committee which dealt with this question, and Adams was asked to call later; when the visit was repeated, Airy was unfortunately at dinner (and it may be added that his hours for dinner were somewhat peculiar), and the butler, acting somewhat in the manner of his kind, protected his master's dinner by sending away one whom he doubtless regarded as a troublesome visitor. There is, as I have said, little doubt about any of the facts, and it seems well established that Airy himself did not learn of Adams' visits until afterwards, and it would scarcely be just to blame him for a servant's oversight. But Adams had left the paper above reproduced, and Airy with his business-like habits ultimately proceeded to deal with it; he wrote the answer given above asking Adams a definite question, filed a copy of it with the original letter, and then dismissed the matter from his thoughts until the reply from Adams, which he confidently expected should again bring it under notice.

This further disappointment was, however, too much for Adams; he regarded the question put by Airy as having so obvious an answer that it was intended as an evasion, though this was far from being the case. Airy was thoroughly in earnest about his question, though it must be admitted that a more careful study of the problem would have shown him that it was unnecessary. Later, when he learnt of Le Verrier's researches, he put the same question to him, and received a polite but very clear answer, showing that the suggested test was not an *_experimentum crucis_* as he supposed. But Adams did not feel equal to making this reply; he shrank into his shell and solaced himself only by commencing afresh another solution of

the problem which had so engrossed his life at that time.

[Sidenote: The merits of Airy's question.]

[Sidenote: The range of possibilities.]

I have heard severe or contemptuous things said about this question by those who most blame Airy. Some of them have no hesitation in accusing him of intellectual incompetence: they say that it was the question of a stupid man. I think that in the first place they forget the difference between a deliberate error of judgement and a mere consequence of insufficient attention. But there is even more than this to be said in defence of the question. The "error of radius vector" came before Airy in an entirely independent way, and as an entirely independent phenomenon, from the "error of longitude," and there was nothing unnatural in regarding it as requiring independent explanation. It is true that, _as the event proved_, a mere readjustment of the orbit of Uranus got rid of this error of radius vector (this was substantially Le Verrier's answer to Airy's question); but we must not judge of what was possible before the event in the light of what we now know. The original possibilities were far wider, though we have forgotten their former extent now that they have been narrowed down by the discovery. If a sentry during war time hears a noise in a certain direction, he may be compelled to make the assumption that it is the movement of an enemy; and if he fires in that direction and kills him, and thus saves his own army from destruction, he is deservedly applauded for the success which attends his action. But it does not follow that the assumption on which he acted was the only possible one. Or, to take a more peaceful illustration, in playing whist it sometimes becomes apparent that the game can only be won if the cards lie in a certain way; and a good player will thereupon assume that this is the fact, and play accordingly. Adams and Le Verrier played to win the game on the particular assumption that the disturbance of Uranus was due to an external planet revolving at a distance from the sun about twice that of Uranus; _and won it_; and we applaud them for doing so. But it is easy to imagine a rearrangement of the cards with which they would have lost it; and Airy's question simply meant that he was alive to these wider possibilities, and did not see the need for attempting to win the game in that particular way.

One such alternative possibility has already been mentioned. "Hansen's opinion was, that one disturbing body would not satisfy the phenomena; but he conjectured that there were two planets beyond _Uranus_." Another conceivable alternative is that there was some change in the law of gravitation at the distance of Uranus, which, it must be remembered, is twice as great as that of any planet previously known. Or some wandering body might have passed close enough to Uranus to change its orbit somewhat

suddenly. We now know, for instance, that the swarm of meteorites which gives rise to the well-known "November meteors" must have passed very close to Uranus in A.D. 126, assuming that neither the planet nor the swarm have been disturbed in any unknown manner in the meantime. It is to this encounter that we owe the introduction of this swarm to our solar system: wandering through space, they met Uranus, and were swept by his attraction into an orbit round the sun. Was there no reaction upon Uranus himself? The probabilities are that the total mass of the swarm was so small as to affect the huge planet inappreciably; but who was to say that some other swarm of larger mass, or other body, might not have approached near Uranus at some date between 1690 and 1845, and been responsible at any rate in part for the observed errors? These are two or three suppositions from our familiar experience; and there are, of course, limitless possibilities beyond. Which is the true scientific attitude, to be alive to them all, or to concentrate attention upon one?

But we are perhaps wandering too far from the main theme. It is easy to do so in reviewing this extraordinary piece of history, for at almost every point new possibilities are suggested.

[Sidenote: Airy receives Le Verrier's memoir.]

We must return, however, to Airy's "account." We reached the point where he had written to Adams (on November 5, 1845), asking his question about the radius vector, and received no reply; and there the matter remained, so far as he was concerned, until the following June, when Le Verrier's memoir reached him; and we will let him give his own version of the result.

"This memoir reached me about the 23rd or 24th of June. I cannot sufficiently express the feeling of delight and satisfaction which I received from it. The place which it assigned to the disturbing planet was the same, to one degree, as that given by Mr. Adams' calculations, which I had perused seven months earlier. To this time I had considered that there was still room for doubt of the accuracy of Mr. Adams' investigations; for I think that the results of algebraic and numerical computations, so long and so complicated as those of an inverse problem of perturbations, are liable to many risks of error in the details of the process: I know that there are important numerical errors in the *__Mécanique Céleste__* of Laplace; in the *__Théorie de la Lune__* of Plana; above all, in Bouvard's first tables of *__Jupiter__* and *__Saturn__*; and to express it in a word, I have always considered the correctness of a distant mathematical result to be a subject rather of moral than of mathematical evidence. But now I felt no doubt of the accuracy of both calculations, as applied to the perturbation in longitude. I was, however, still desirous, as before,

of learning whether the perturbation in radius vector was fully explained. I therefore addressed to M. Le Verrier the following letter:--

No. 13.--G. B. AIRY _to_ M. LE VERRIER.

"Royal Observatory, Greenwich, _1846, June 26_.

[Sidenote: He puts the "radius-vector" question to Le Verrier, but makes no mention of Adams.]

"I have read, with very great interest, the account of your investigations on the probable place of a planet disturbing the motions of _Uranus_, which is contained in the _Compte Rendu de l'Académie_ of June 1; and I now beg leave to trouble you with the following question. It appears, from all the later observations of _Uranus_ made at Greenwich (which are most completely reduced in the _Greenwich Observations_ of each year, so as to exhibit the effect of an error either in the tabular heliocentric longitude, or the tabular radius vector), that the tabular radius vector is considerably too small. And I wish to inquire of you whether this would be a consequence of the disturbance produced by an exterior planet, now in the position which you have indicated?"

There is more of the letter, but this will suffice to show that he wrote to Le Verrier in the same way as to Adams, and, as already stated, received a reply dated three or four days later. But the rest of the letter contains no mention of Adams, and thus arises a second difficulty in understanding Airy's conduct. It seems extraordinary that when he wrote to Le Verrier he made no mention of the computations which he had previously received from Adams; or that he should not have written to Adams, and made some attempt to understand his long silence, now that, as he himself states, he "felt no doubt of the accuracy of both calculations." The omission may have been, and probably was, mere carelessness or forgetfulness; but he could hardly be surprised if others mistook it for deliberate action.

[Sidenote: Airy announces the likelihood of a new planet, and suggests a search for it at Cambridge not having suitable telescope at Greenwich]

However, attention had now been thoroughly attracted to the near possibility of finding the planet. On June 29, 1846, there was a special meeting of the Board of Visitors of Greenwich Observatory, and Airy incidentally mentioned to them this possibility. The impression produced must have been definite and deep; for Sir John Herschel, who was present,

was bold enough to say on September 10th following to the British Association assembled at Southampton: "We see it (the probable new planet) as Columbus saw America from the shores of Spain. Its movements have been felt trembling along the far-reaching line of our analysis with a certainty hardly inferior to that of ocular demonstration." Airy discussed the matter with Professor Challis (who, it will be remembered, had originally written to him on behalf of Adams), suggesting that he should immediately commence a search for the supposed planet at Cambridge. It may be asked why Airy did not commence this search himself at Greenwich, and the answer is that he had no telescope which he regarded as large enough for the purpose. The Royal Observatory at Greenwich has always been, and is now, better equipped in some respects than any other observatory, as might be expected from its deservedly great reputation; but to possess the largest existing telescope has never been one of its ambitions. The instruments in which it takes most pride are remarkable for their steadiness and accuracy rather than for their size; and at that time the best telescope possessed by the observatory was not, in Airy's opinion, large enough to detect the planet with certainty. In this opinion we now know that he was mistaken; but, again, we must not judge his conduct before the event in the light of what we have since discovered. It may be recalled here that it was not until Le Verrier's third paper, published on August 31, that he (Le Verrier) emphatically pointed out that the new planet might be of such a size as to have a sensible disc; and it was this remark which led immediately to its discovery. Until this was so decisively stated, it must have seemed exceptionally improbable; for we saw in the last chapter how diligently the Zodiac had been swept in the search for minor planets,--how, for instance, Hencke had searched for fifteen years without success; and it might fairly be considered that if there were a fairly bright object (such as Neptune has since been found to be) it would have been discovered earlier. Hence Airy not unreasonably considered it necessary to spread his net for very small objects. On July 9 he wrote to Professor Challis as follows:--

No. 15.--G. B. AIRY _to_ PROFESSOR CHALLIS.

"THE DEANERY, ELY, _1846, July 9_.

"You know that I attach importance to the examination of that part of the heavens in which there is ... reason for suspecting the existence of a planet exterior to _Uranus_. I have thought about the way of making such examination, but I am convinced that (for various reasons, of declination, latitude of place, feebleness of light, and regularity of superintendence) there is no prospect whatever of its being made with any chance of success, except with the Northumberland telescope.

"Now, I should be glad to ask you, in the first place, whether you could make such an examination?

"Presuming that your answer would be in the negative, I would ask, secondly, whether, supposing that an assistant were supplied to you for this purpose, you would superintend the examination?

"You will readily perceive that all this is in a most unformed state at present, and that I am asking these questions almost at a venture, in the hope of rescuing the matter from a state which is, without the assistance that you and your instruments can give, almost desperate. Therefore I should be glad to have your answer, not only responding simply to my questions, but also entering into any other considerations which you think likely to bear on the matter.

"The time for the said examination is approaching near."

[Sidenote: Challis undertakes the search.]

[Sidenote: He finds too late that he had observed the planet.]

Professor Challis did not require an assistant, but determined to undertake the work himself, and devised his own plan of procedure; but he also set out on the undertaking with the expectation of a long and arduous search. No such idea as that of finding the planet on the first night ever entered his head. For one thing, he had no map of the region to be examined, for although the map used by Galle had been published, no copy of it had as yet reached Cambridge, and Professor Challis had practically to construct a map for himself. In these days of photography to make such a map is a simple matter, but at that time the process was terribly laborious. "I get over the ground very slowly," he wrote on September 2nd to Airy, "thinking it right to include all stars to 10-11 magnitude; and I find that to scrutinise thoroughly in this way the proposed portion of the heavens will require many more observations than I can take this year." With such a prospect, it is not surprising that one night's observations were not even compared with the next; there would be a certain economy in waiting until a large amount of material had been accumulated, and then making the comparisons all together, and this was the course adopted. But when Le Verrier's third paper, with the decided opinion that the planet would be bright enough to be seen by its disc, ultimately reached Professor Challis, it naturally gave him an entirely different view of the possibilities; he immediately began to compare the observations already made, and found that he had observed the planet early in August. But it was now too late to be first in the field, for Galle had already made his announcement of discovery. Writing to Airy on October 12, Challis could only lament that after four days' observing the planet was in his grasp,

if only he had examined or mapped the observations, and _if_ he had not delayed doing so until he had more observations to reduce, and _if_ he had not been very busy with some comet observations. Oh! these terrible _ifs_ which come so often between a man and success! The third of them is a peculiarly distressing one, for it represents that eternal conflict between one duty and another, which is so constantly recurring in scientific work. Shall we finish one piece of work now well under way, or shall we attend to something more novel and more attractive? Challis thought his duty lay in steadily completing the comet observations already begun. We saw in the last lecture how the steady pursuit of the discovery of minor planets, a duty which had become tedious and apparently led nowhere, suddenly resulted in the important discovery of Eros. But Challis was not so fortunate in electing to plod along the beaten track; he would have done _better_ to leave it. There is no golden rule for the answer; we must be guided in each case by the special circumstances, and the dilemma is consequently a new one on every occasion, and perhaps the more trying with each repetition.

[Sidenote: Sensation caused by the discovery.]

[Sidenote: Not all _national_ jealousy.]

Such are briefly the events which led to the discovery of Neptune, which was made in Germany by direction from France, when it might have been made in Cambridge alone. The incidents created a great stir at the time. The "Account" of them, as read by Airy to the Royal Astronomical Society on November 13, 1846, straightforward and interesting though it was, making clear where he had himself been at fault, nevertheless stirred up angry passions in many quarters, and chiefly directed against Airy himself. Cambridge was furious at Airy's negligence, which it considered responsible for costing the University a great discovery; and others were equally irate at his attempting to claim for Adams some of that glory which they considered should go wholly to Le Verrier. But it may be remarked that feeling was not purely national. Some foreigners were cordial in their recognition of the work of Adams, while some of those most eager to oppose his claims were found in this country. In their anxiety to show that they were free from national jealousy, scientific men went almost too far in the opposite direction.

[Sidenote: The position of Cambridge in the matter.]

[Sidenote: Challis the weakest point.]

Airy's conduct was certainly strange at several points, as has already been remarked. One cannot understand his writing to Le Verrier in June 1846 without any mention of Adams. He could not even momentarily have

forgotten Adams' work; for he tells us himself how he noticed the close correspondence of his result with that of Le Verrier: and had he even casually mentioned this fact in writing to the latter, it would have prepared the way for his later statement. But we can easily understand the unfavourable impression produced by this statement after the discovery had been made, when there had been no previous hint on the subject at all. Of those who abused him Cambridge had the least excuse; for there is no doubt that with a reasonably competent Professor of Astronomy in Cambridge, she need not have referred to Airy at all. It would not seem to require any great amount of intelligence to undertake to look in a certain region for a strange object if one is in possession of a proper instrument. We have seen that Challis had the instrument, and when urged to do so was equal to the task of finding the planet; but he was a man of no initiative, and the idea of doing so unless directed by some authority never entered his head. He had been accustomed for many years to lean rather helplessly upon Airy, who had preceded him in office at Cambridge. For instance, when appointed to succeed him, and confronted with the necessity of lecturing to students, he was so helpless that he wrote to implore Airy to come back to Cambridge and lecture for him; and this was actually done, Airy obtaining leave from the Government to leave his duties at Greenwich for a time in order to return to Cambridge, and show Challis how to lecture. Now it seems to me that this helplessness was the very root of all the mischief of which Cambridge so bitterly complained. I claimed at the outset the privilege of stating my own views, with which others may not agree: and of all the mistakes and omissions made in this little piece of history, the most unpardonable and the one which had most serious consequences seems to me to be this: that Challis never made the most casual inquiry as to the result of the visit to Greenwich which he himself had directed Adams to make. I am judging him to some extent by default; because I assume the facts from lack of evidence to the contrary: but it seems practically certain that after sending this young man to see Airy on this important topic, Challis thereupon washed his hands of all responsibility so completely that he never even took the trouble to inquire on his return, "Well! how did you get on? What did the Astronomer Royal say?" Had he put this simple question, which scarcely required the initiative of a machine, and learnt in consequence, as he must have done, that the sensitive young man thought Airy's question trivial, and did not propose to answer it, I think we might have trusted events to right themselves. Even Challis might have been trusted to reply, "Oh! but you must answer the Astronomer Royal's question: you may think it stupid, but you had better answer it politely, and show him that you know what you are about." It is unprofitable to pursue speculation further; this did not happen, and something else did. But I have always felt that my old University made a scapegoat of the wrong man in venting its fury upon Airy, when the real culprit was among themselves, and was the man they had themselves chosen to represent astronomy. He was presumably the best they had; but if they

had no one better than this, they should not have been surprised, and must not complain, if things went wrong. If a University is ambitious of doing great things, it must take care to see that there are men of ability and initiative in the right places. This is a most difficult task in any case, and we require all possible incentives towards it. To blink the facts when a weak spot is mercilessly exposed by the loss of a great opportunity is to lose one kind of incentive, and perhaps not the least valuable.

[Sidenote: Curious difference between actual and supposed planet.]

[Sidenote: Professor Peirce's contention that the discovery was a mere accident.]

[Sidenote: The explanation.]

Let us now turn to some curious circumstances attending this remarkable discovery of a planet by mathematical investigation, of which there are several. The first is, that although Neptune was found so near the place where it was predicted, its orbit, after discovery, proved to be very different from that which Adams and Le Verrier had supposed. You will remember that both calculators assumed the distance from the sun, in accordance with Bode's Law, to be nearly twice that of Uranus. The actual planet was found to have a mean distance less than this by 25 per cent., an enormous quantity in such a case. For instance, if the supposed planet and the real were started round the sun together, the real planet would soon be a long way ahead of the other, and the ultimate disturbing effect of the two on Uranus would be very different. To explain the difference, we must first recall a curious property of such disturbances. When two planets are revolving, so that one takes just twice or three times, or any exact number of times, as long to revolve round the sun as the other, the usual mathematical expressions for the disturbing action of one planet on the other would assign an _infinite_ disturbance, which, translated into ordinary language, means that we must start with a fresh assumption, for this state of things cannot persist. If the period of one were a little _longer_ than this critical value, some of the mathematical expressions would be of contrary sign from those corresponding to a period a little _shorter_. Now it is curious that the supposed planet and the real had orbits on opposite sides of a critical value of this kind, namely, that which would assign a period of revolution for Neptune exactly half that of Uranus; and it was pointed out in America by Professor Peirce that the effect of the planet imagined by Adams and Le Verrier was thus totally different from that of Neptune. He therefore declared that the mathematical work had not really led to the discovery at all; but that it had resulted from mere coincidence, and this opinion--somewhat paradoxical though it was--found considerable support. It was not replied to by Adams until some thirty years later, when a short reply was printed in

Liouville's Journal. The explanation is this: the expressions considered by Professor Peirce are those representing the action of the planet throughout an indefinite past, and did not enter into the problem, which would have been precisely the same if Neptune had been suddenly created in 1690; while, on the other hand, if Neptune had existed up till 1690 (the time when Uranus was first observed, although unknowingly), and then had been destroyed, there would have been no means of tracing its previous existence. In past ages it had no doubt been perturbing the orbit of Uranus, and had effected large changes in it; but if it had then been suddenly destroyed, we should have had no means of identifying these changes. There might have been instead of Neptune another planet, such as that supposed by Adams and Le Verrier; and its action in all past time would have been very different from that of Neptune, as is properly represented in the mathematical expressions which Professor Peirce considered. In consequence the orbit of Uranus in 1690 would have been very different from the orbit as it was actually found; but in either case the mathematicians Adams and Le Verrier would have had to take it as they found it; and the disturbing action which they considered in their calculations was the comparatively small disturbance which began in 1690 and ended in 1846. During this limited number of years the disturbance of the planet they imagined, although not precisely the same as that of Neptune, was sufficiently like it to give them the approximate place of the planet.

Still it is somewhat bewildering to look at the mathematical expressions for the disturbances as used by Adams and Le Verrier, when we can now compare with them the actual expressions to which they ought to correspond; and one may say frankly that there seems to be no sort of resemblance. Recently a memorial of Adams' work has been published by the Royal Astronomical Society; they have reproduced in their Memoirs a facsimile of Adams' MS. containing the "first solution," which he made in 1843 in the Long Vacation after he had taken his degree, and which would have given the place of Neptune at that time with an error of 15° . In an introduction describing the whole of the MSS., written by Professor R. A. Sampson of Durham, it is shown how different the actual expressions for Neptune's influence are from those used by Adams, and it is one of the curiosities of this remarkable piece of history that some of them seem to be actually in the wrong direction; and others are so little alike that it is only by fixing our attention resolutely on the considerations above mentioned that we can realise that the analytical work did indeed lead to the discovery of the planet.

[Sidenote: Suggested elementary method for finding Neptune illusory.]

A second curiosity is that a mistaken idea should have been held by at least one eminent man (Sir J. Herschel), to the effect that it would have

been possible to find the place of the planet by a much simpler mathematical calculation than that actually employed by Adams or Le Verrier. In his famous "Outlines of Astronomy" Sir John Herschel describes a simple graphical method, which he declares would have indicated the place of the planet without much trouble. Concerning it I will here merely quote Professor Sampson's words:--

"The conclusion is drawn that _Uranus_ arrived at a conjunction with the disturbing planet about 1822; and this was the case. Plausible as this argument may seem, it is entirely baseless. For the maximum of perturbations depending on the eccentricities has no relation to conjunction, and the others which depend upon the differences of the mean motions alone are of the nature of forced oscillations, and conjunction is not their maximum or stationary position, but their position of most rapid change."

Professor Sampson goes on to show that a more elaborate discussion seems quite as unpromising; and he concludes that the refinements employed were not superfluous, although it seems _now_ clear that a different mode of procedure might have led more certainly to the required conclusion.

[Sidenote: The evil influence of Bode's Law.]

For the third curious point is that both calculators should have adhered so closely to Bode's Law. If they had not had this guiding principle it seems almost certain that they would have made a better approximation to the place of the planet, for instead of helping them it really led them astray. We have already remarked that if two planets are at different distances from the sun, however slight, and if they are started in their revolution together, they must inevitably separate in course of time, and the amount of separation will ultimately become serious. Thus by assuming a distance for the planet which was in error, however slight, the calculators immediately rendered it impossible for themselves to obtain a place for the planet which should be correct for more than a very brief period. Professor Sampson has given the following interesting lists of the dates at which Adams' six solutions gave the true place of the planet and the intervals during which the error was within 5° either way.

I. II. III. IV. V. VI.

Correct 1820 1835 1872 1830 1861 1856

Within $\pm 5^\circ$ {1812 1827 1865 1813 1815 1826
 {1827 1842 1877 1866 1871 1868

Now the date at which it was most important to obtain the correct place

was 1845 or thereabouts when it was proposed to look for the planet; but no special precaution seems to have been taken by either investigator to secure any advantage for this particular date. Criticising the procedure after the event (and of course this is a very unsatisfactory method of criticism), we should say that it would have been better to make several assumptions as regards the distance instead of relying upon Bode's Law; but no one, so far as I know, has ever taken the trouble to write out a satisfactory solution of the problem as it might have been conducted. Such a solution would be full of interest, though it could only have a small weight in forming our estimation of the skill with which the problem was solved in the first instance.

[Sidenote: Le Verrier's erroneous limits.]

Fourthly, we may notice a very curious point. Le Verrier went to some trouble not only to point out the most likely place for the planet, but to indicate limits outside which it was not necessary to look. This part of his work is specially commented upon with enthusiasm by Airy, and I will reproduce what he says. It is rather technical perhaps, but those who cannot follow the mathematics will be able to appreciate the tone of admiration.

[Sidenote: The visible disc.]

"M. Le Verrier then enters into a most ingenious computation of the limits between which the planet must be sought. The principle is this: assuming a time of revolution, all the other unknown quantities may be varied in such a manner that though the observations will not be so well represented as before, yet the errors of observation will be tolerable. At last, on continuing the variation of elements, one error of observation will be intolerably great. Then, by varying the elements in another way, we may at length make another error of observation intolerably great; and so on. If we compute, for all these different varieties of elements, the place of the planet for 1847, its *_locus_* will evidently be a discontinuous curve or curvilinear polygon. If we do the same thing with different periodic times, we shall get different polygons; and the extreme periodic times that can be allowed will be indicated by the polygons becoming points. These extreme periodic times are 207 and 233 years. If now we draw one grand curve, circumscribing all the polygons, it is certain that the planet must be within that curve. In one direction, M. Le Verrier found no difficulty in assigning a limit; in the other he was obliged to restrict it, by assuming a limit to the eccentricity. Thus he found that the longitude of the planet was certainly not less than 321° , and not greater than 335° or 345° , according as we limit the eccentricity to 0.125 or 0.2. And if we

adopt 0.125 as the limit, then the mass will be included between the limits 0.00007 and 0.00021; either of which exceeds that of Uranus. From this circumstance, combined with a probable hypothesis as to the density, M. Le Verrier concluded that the planet would have a visible disk, and sufficient light to make it conspicuous in ordinary telescopes.

"M. Le Verrier then remarks, as one of the strong proofs of the correctness of the general theory, that the error of radius vector is explained as accurately as the error of longitude. And finally, he gives his opinion that the latitude of the disturbing planet must be small.

"My analysis of this paper has necessarily been exceedingly imperfect, as regards the astronomical and mathematical parts of it; but I am sensible that, in regard to another part, it fails totally. I cannot attempt to convey to you the impression which was made on me by the author's undoubting confidence in the general truth of his theory, by the calmness and clearness with which he limited the field of observation, and by the firmness with which he proclaimed to observing astronomers, 'Look in the place which I have indicated, and you will see the planet well.' Since Copernicus declared that, when means should be discovered for improving the vision, it would be found that Venus had phases like the moon, nothing (in my opinion) so bold, and so justifiably bold, has been uttered in astronomical prediction. It is here, if I mistake not, that we see a character far superior to that of the able, or enterprising, or industrious mathematician; it is here that we see the philosopher."

[Sidenote: Peirce's views of the limits.]

But now this process of limitation was faulty and actually misleading. Let us compare what is said about it by Professor Peirce a little later.

"Guided by this principle, well established, and legitimate, if confined within proper limits, M. Le Verrier narrowed with consummate skill the field of research, and arrived at two fundamental propositions, namely:--

"1st. That the mean distance of the planet cannot be less than 35 or more than 37.9. The corresponding limits of the time of sidereal revolution are about 207 and 233 years.

"2nd. 'That there is only one region in which the disturbing planet can be placed in order to account for the motions of Uranus; that the mean longitude of this planet must have been, on January 1, 1800,

between 243° and 252° .'

"Neither of these propositions is of itself necessarily opposed to the observations which have been made upon Neptune, but the two combined are decidedly inconsistent with observation. It is impossible to find an orbit, which, satisfying the observed distance and motion, is subject to them. If, for instance, a mean longitude and time of revolution are adopted according with the first, the corresponding mean longitude in 1800 must have been at least 40° distant from the limits of the second proposition. And again, if the planet is assumed to have had in 1800 a mean longitude near the limits of the second proposition, the corresponding time of revolution with which its motions satisfy the present observations cannot exceed 170 years, and must therefore be about 40 years less than the limits of the first proposition.'

"Neptune cannot, then, be the planet of M. Le Verrier's theory, and cannot account for the observed perturbations of Uranus under the form of the inequalities involved in his analysis"--(Proc. Amer. Acad. I., 1846-1848, p. 66).

[Sidenote: Newcomb's criticism.]

At the time when Professor Peirce wrote, the orbit of Neptune was not sufficiently well determined to decide whether one of the two limitations might not be correct, though he could see that they could not both be right, and we now know that they are both wrong. The mean distance of Neptune is 30, which does not lie between 35 and 37.9; and the longitude in 1800 was 225° , which does not lie between 243° and 252° . The ingenious process which Airy admired and which Peirce himself calls "consummately skilful" was wrong in principle. As Professor Newcomb has said, "the error was the elementary one that, instead of considering all the elements simultaneously variable, Le Verrier took them one at a time, considering the others as fixed, and determining the limits between which each could be contained on this hypothesis. No solver of least square equations at the present day ought to make such a blunder. Of course one trouble in Le Verrier's demonstration, had he attempted a rigorous one, would have been the impossibility of forming the simultaneous equations expressive of possible variations of all the elements."

[Sidenote: Element of good fortune.]

[Sidenote: The map used by Galle.]

The account of Le Verrier's limits by Professor Peirce, though it exhibits the error with special clearness, is a little unfair to Le Verrier in one

point. If, instead of taking the limits for the date 1800, we take them for 1846 (when the search for Neptune was actually made), we shall find that they do include the actual place of the planet, as Airy found. The erroneous mean motion of Le Verrier's planet allowed of his being right at one time and wrong at another; and Airy examined the limits under favourable conditions, which explains his enthusiasm. But we can scarcely wonder that Professor Peirce came to the conclusion that the planet discovered was not the one pointed out by Le Verrier, and had been found by mere accident. And all these circumstances inevitably contribute to a general impression that the calculators had a large element of good fortune to thank for their success. Nor need we hesitate to make this admission, for there is an element of good fortune in all discoveries. To look no further than this--if a man had not been doing a particular thing at a particular time, as he might easily not have been, most discoveries would never have been made. If Sir William Herschel had not been looking at certain small stars for a totally different purpose he would never have found Uranus; and no one need hesitate to admit the element of chance in the finding of Neptune. It is well illustrated by a glance at the map which, as has been remarked, Galle used to compare with the sky on the night when he made the actual discovery. The planet was found down near the bottom corner of the map, and since the limits assigned for its place might easily have varied a few degrees one way or the other, it might easily have been off the map; in which case, it is probable that the search would not have been successful, or at any rate that success would have been delayed.

[Illustration: V.--CORNER OF THE BERLIN MAP, BY THE USE OF WHICH GALLE FOUND NEPTUNE.]

[Sidenote: Every one made mistakes.]

Thus, it is a most remarkable feature of the discovery of Neptune that mistakes were made by almost every one concerned, however eminent. Airy made a mistake in regarding the question of the Radius Vector as of fundamental importance; Sir J. Herschel was wrong in describing an elementary method which he considered might have found the planet; Professor Peirce was wrong in supposing that the actual and the supposed planet were essentially different in their action on Uranus; Le Verrier was wrong in assigning limits outside which it was not necessary to look when the actual planet was outside them; Adams was more or less wrong in thinking that the eccentricity of the new planet could be found from the material already at disposal of man. Both Adams and Le Verrier gave far too much importance to Bode's Law.

To review a piece of history of this kind and note the mistakes of such men is certainly comforting, and need not in any way lessen our

admiration. In the case of the investigators themselves, much may be set down to excitement in the presence of a possible discovery. Professor Sampson has provided us with a small but typical instance of this fact. When Adams had carried through all his computations for finding Neptune, and was approaching the actual place of the planet, he, "who could carry through fabulous computations without error," for the first time wrote down a wrong figure. The mistake was corrected upon the MS., "probably as soon as made," but no doubt betrays the excitement which the great worker could not repress at this critical moment. There is a tradition that, similarly, when the mighty Newton was approaching the completion of his calculations to verify the Law of Gravitation, his excitement was so great that he was compelled to assign to a friend the task of finishing them.

Finally, we may remark how the history of the discovery of Neptune again illustrates the difficulty of formulating any general principles for guiding scientific work. Sometimes it is well to follow the slightest clue, however imperfectly understood; at other times we shall do better to refuse such guidance. Bode's Law pointed to the existence of minor planets, and might conceivably have helped in finding Uranus: but by trusting to it in the case of Neptune, the investigators were perilously near going astray. Sometimes it is better to follow resolutely the work in hand whatever it may be, shutting one's ears to other calls; but Airy and Challis lost their opportunities by just this course of action. The history of science is full of such contradictory experiences; and the only safe conclusion seems to be that there are no general rules of conduct for discovery.

PUSSY S PATIENCE AND CLEANLINESS.

from *Cats*, by W. Gordon Stables

EBook #43429

Next to a cat's love for children, if there is one thing more than another that ought to make one love her and respect her as a pet, it is the extreme patience which she evinces under sufferings, sometimes the most acute. We talk about dogs being game, and taking their death easy; and so they mostly do under excitement; but in long lingering illnesses, pussy is a much better patient.

Pussy, moreover, is blessed with extreme good-nature, and will pardon almost any injury from one she loves. I have no patience with people who say that cats are unforgiving, or that "a friendship of years may be cancelled in a moment, by an accidental tread on its tail or feet." "Look," the same parties will tell you, "how patiently a dog will bear a like accident."

Ay; but, say I, you must bear in mind three things:--First, a dog is generally larger than a cat, and a tread is consequently a mere trifle to him. Secondly, a cat is ten times more sensitive to pain than a dog. And, thirdly, a cat has so many enemies of all sorts, that she must be for ever on the alert to avert danger; not knowing when a foe may pounce upon her, she has to sleep even with open ears. Is it any wonder, then, that, when roused from slumber by a cruel and painful tread on her tail, she should start up and show fight, or run off growling--perhaps, indeed, only half-awake? But malice she never harbours in her heart; and in half an hour, when she has thought the matter over, she will creep from under the sofa or bed, to fondly caress the very one who hurt her.

No animal appreciates kindness more than a cat. Witness the gratitude even a poor stray will evince, to any one who may have fed it when hungry.

"Not long ago," writes a lady to me, "a cat (one of the kind kept as a machine) used to frequent our garden, starved enough, poor thing, as its knotty fur betokened; so, having a trap set in our house to catch mice, and being always more or less successful in catching the vermin, I one day took the trap, with a mouse in it, to the garden, and by dint of very little persuasion, managed to get near this cat waif, and give it the mouse. That was quite enough; it got them ever after, so long as it was in life; and invariably from that date whenever it saw me in the garden, it would come bounding to me. And I am sure, by its dumb delight, it well repaid me, showing that it fully appreciated both the voice, and hand of kindness."

It is this same patience in her nature, that makes our domestic cat such

an excellent hunter and vermin killer. We all know how patiently she will sit in a corner, and watch for a mouse or rat. She knows very well it will come sooner or later, and she is always rewarded with success. She is the same in the hunting-field, waiting for hours at the door of a rabbit-burrow, till poor Bunny, or some one of her children, peeps out; then, "I'll have you," says puss, and forthwith walks it off. Or, hidden under a heather hillock, or a turnip-leaf, she will wait and wait, and never weary, until she can secure a beautiful grouse, or plump little partridge. Witness their patience and long-suffering with children,--this I have already spoken about, and need not repeat,--having proved, in a former chapter, that they not only bear, but even seem to like, a certain amount of rough treatment at baby hands.

Tucker was about the best-natured lump of a cat I ever knew. You might have done anything with him--flung him over the church for instance. If you had, I dare be sworn, Tucker would have alighted on his feet at the other side, and gone quietly off to sleep. No, he was not a particularly good hunter, he was hardly cruel enough to kill a mouse; but he had a spirit of his own for all that, and if you had shaken your finger at him, he would have let you have it straight from the shoulder.

Tucker used to submit himself, quietly, to be tied up in a towel, and placed in a scale opposite a leg of mutton, or Scotch cheese. He was once sent a distance of thirty yards, trussed up in this fashion, to a shopkeeper's place, to be weighed. Tucker went through the operation so patiently, that the grocer never suspected till the very last.

"A good solid hare," he said, feeling the bundle; "but bless me, isn't he warm? Do you think he is really dead?"

"Err-a-wa-ow," said Tucker, popping out his head at a corner, as much as to say, "Not just yet, friend;" and the laugh was all against the grocer.

How patiently a cat will wait for her dinner, until every one else is served, reminding you only then, by her loud singing and demonstrative kindness, that there is still a little hole in her stomach that wants filling! And, how patiently sit and wait, and watch for the return of her master or mistress, be they never so long absent! She knows their footsteps, and jumps up at their knock, and runs to the door to meet them.

I know of a poor cat that was for a whole fortnight in a trap. The cruel keepers had left him for all that time, without either food or drink; he was afterwards discovered by his owner, and taken home. Although a beautiful large Tom tabby when he left home, he was reduced to a perfect skeleton. His leg had to be amputated; but he bore the operation without flinching, struggling a little at first only, but giving vent to no

expression of pain. He made a very good recovery; but, being one of the mighty-hunter persuasion, as soon as he was perfectly recovered, he hopped off to the woods again. He did not return, however, and for two years was not seen again; but one dark night, his master, on passing through a wood, had his attention attracted by the cries of a cat. The animal was in a tree; and, on the gentleman's approach, it sprang down, and commenced rubbing round his legs, with every expression of affection and kindness. On bending down to caress it, the gentleman was surprised to find it had only three legs. It followed him home, and he then made certain it was none other than his long-lost pet. It stopped at home for many a day after this, and seemed in no way inconvenienced from the loss of its hind-leg. But travellers never can settle, and puss took to the woods again, and this time fell a victim to the keeper's vengeance.

Another cat of my acquaintance was in like manner caught in a trap, and had to endure amputation of the leg; although in much suffering and pain, it bore it without a murmur.

"I witnessed, only last week," says a young lady, "while residing with my married sister, down in Kent, an instance of great patience and endurance in a cat. A Dandie Dinmont dog was dragging her round and round the garden walks by the tail, and instead of being annoyed, pussy seemed really to enjoy it."

Cats know as well as human beings, that, when you are examining and treating their hurts--whether inflicted by traps or stones--you mean to do them good. Cats, even strange cats, often lick my hands when I am probing a wound and inflicting the most severe pain on them.

Cats always show gratitude by licking your hand; it is the greatest compliment a cat can pay you, for they are not so ready as dogs, to sow their kisses and caresses broad-cast.

I was amused the other day, at seeing the care and attention a little girl was bestowing on a pet cat. Tom had been out all night, and came in next day on three legs; the one he carried was wounded, bruised, and much swollen, and Tom himself looked generally seedy and out of sorts. Now, had it been a boy instead of a girl, he would, in all probability, have done nothing useful. But females are always practical; and this embryo Miss Nightingale, after having a good cry, set about at once to put matters straight for poor Tom. She bathed the leg in warm water, and encircled it with a large poultice. Then she rolled him in an old shawl, and put him to bed in a basket. Tom kept his bed for ten days, during which time, she fed him from a plate, not allowing him to get up; and every time the poultice was changed, the cat licked her hand in evident gratitude. In fact, Tom made the best of patients, being more like a sincere Christian than

anything else; and his little nurse was finally rewarded, by having her pet gambolling around her as usual.

A cat, some time ago, received a charge of ragged shot in his shoulder. He fainted from loss of blood, and afterwards had high fever, just as a human being would have done, under like circumstances. The greater portion of the shot was extracted, or worked out in the process of healing; one portion, however, pussy carried to his grave with him. During the painful process of having his wounds probed for shot, pussy never even groaned.

But it is in long and severe illnesses that pussy's patience is best exemplified.

A poor cat, many years ago, took a severe illness--jaundice. He was a fine large Tom cat, of the name of Tacket, and a very great pet; but in a short time he got reduced to a mere bag of bones; his fine fur came out in parts, and in parts hung about him like tassels. So pitiful an object looked he, that his master and mistress had the sin of keeping him alive forcibly pointed out to them by their friends. Indeed, he was now so weak as to be unable to move from his bed by the kitchen fire. On the 10th day, when he was at his very worst, a little raw meat was given him; and, his head being supported, he managed to swallow it. This was the turning point of his illness; he began to rally, and soon got well, and plump, and sleek; and the other day died at the age of twelve. But it was a treat to see how patiently poor Tacket bore his illness. Every morning, when his master went to see him, although he could not rise, he tried to sing. But the power of purring left him as he got weaker; on the 9th day he could just sing one bar, and on the 10th day only one note. This cat had a great dislike, for months afterwards, to milk in any shape or form; from having been continually dosed with it while sick, he used positively to shiver at the sight of it.

But I have, I believe, said enough to prove pussy's claim to the virtues of both patience and gratitude.

Habits of Cleanliness in Cats. It must be allowed, that of all our domestic pets, pussy undoubtedly bears the bell for personal cleanliness. Nature has adorned her with a most beautiful coat, of the softest, silkiest fur and loveliest of colours; and she spares no pains to keep it clean and smart. I firmly believe that the cat is very proud of her appearance, and likes to cut a dash--here again, by the bye, she resembles the female of the human family. Pussy is for ever cleaning and washing at herself. If a well-bred parlour cat, she will never allow a speck of dirt to sully her fur. I can always tell whether a cat is properly cared for, and has sufficient food, by the appearance of her coat. If she is allowed to be hungry, or is badly housed, she soon loses all taste in herself, and

doesn't care a rat's tail how she looks.

When a cat's coat begins to appear rough and stare, it is the first indication of approaching illness; and this symptom will never be unattended to by those who love their pet.

I have known cats take ill and die from having their coats accidentally soiled beyond remedy.

THE PREDACEOUS GROUND BEETLE

(*Chlaenius aestivus*., Say)

From *Book of Monsters*, by Fairchild and Bell-Fairchild

ibid

This creature almost anyone will recognize as a beetle. It is built for running, and its jaws are made for fighting. You have only to catch one and watch it open and shut its jaws to realize that it would bite you if it could. But for all that it is a great friend, for it is what the entomologists call predaceous, and at night or at twilight it hunts everywhere for the larvæ of insects which attack the plants we live on. In its larval state, in which it looks for all the world like a centiped without the "ped," it burrows in the ground in search of the plant destroyers, which think to escape notice by getting under the cover of the soil. It is by nature, then, opposed to the vegetarians, the herbivores, and hunts them wherever they are likely to occur.

When you see a black or dark-brown beetle running swiftly from under some stone or log whirled you have just turned over and which makes faces with its jaws as though it would chew your fingers when you pick it up, you can be quite sure in eight times out of ten that it is one of these carabidæ or predaceous ground beetles, and if you let it drop from your fingers you may be saving the life of a friend, because some day it may eat the worm which, lying close to some pet flower of yours, had planned to cut it off beneath the ground.

It is one of the hardest things in all the world to understand how balanced is this scale of foe and friend. One year there is a wiping out of our insect friends through frost or floods or microscopic disease, and, freed thus from the check which kept their numbers down, the foes to our plants can multiply to such an extent that nothing we can do will save our crops from total failure. Next year, perhaps, the parasitic beetle, finding such a wealth of food to live upon, increases and holds well in check the pest which last year ate up all our plants. Each wave of insect pests could be explained, no doubt, if all the facts were known, and nowadays no one who knows what modern agriculture means will fail to reckon on the risks from losses caused by these pests.

FEIGNED DISEASES

from *Aids to Forensic Medicine and Toxicology*

by W. G. Aitchison Robertson

EBook #19019

Malingering in its various forms is by no means uncommon, and by many is regarded as a disease in itself. It is necessary, however, to distinguish between those cases in which it is feigned for some definite purpose--for example, to escape punishment or avoid public service--and those in which there is adequate motive, and the patient shams simply with the view of exciting sympathy, or from the mere delight of giving trouble. It is not uncommon for individuals summoned on a jury, or to give evidence in the law courts, to apply to their doctor for a certificate, assigning as a cause of exemption neuralgia, or some similar complaint unattended with objective symptoms. In such cases it is well to remind the patient that in most courts such certificates are received with suspicion, and are often rejected, and that the personal attendance of the medical man is required to endorse his certificate on oath.

Malingering has become much more common since the National Health Insurance Act has been passed. The possibility of obtaining a fair sum each week without the necessity of working for it induces many persons either to feign disease or to make recovery from actual disease or accident much more tedious than it ought really to be.

The feasibility of successfully malingering is greatly enhanced by the possession of some chronic organic disease. An old mitral regurgitant murmur is useful for this purpose.

It is not flattering to one's vanity to overlook a case of malingering, but should this occur little harm is done. It is a much more serious matter to accuse a person of malingering when in reality he may be suffering from an organic disease.

Here are some of the diseases which are most frequently feigned:

=Nervous Diseases=, as headache, vertigo, paralysis of limbs, vomiting, sciatica, or incontinence or suppression of urine, spitting of blood; others, again, simulate hysteria, epilepsy, or insanity.

On the other hand, the malingerer may actually produce injuries on his person either to excite commiseration or to escape from work. Thus, the beggar produces ulcers on his legs by binding a penny-piece tightly on

for some days; the hospital patient, in order to escape discharge, produces factitious skin diseases by the application of irritants or caustics.

It is much more difficult to decide whether certain symptoms are due to a real disease which is present, or whether they are merely exaggerations of slight symptoms or simulations of past ones. The miner, after an injury to his back, recovers very slowly, if at all. He is suffering from 'traumatic neurasthenia'--a condition only too often simulated, and a disease very difficult to diagnose accurately. The miner takes advantage of our ignorance, and continues to draw his compensation. A workman during his work receives a fracture; instead of being able to resume work in six weeks, he asserts that the pain and stiffness prevent him, and this disability may persist for months. Such cases as these frequently come before the courts when the employer has discontinued to pay the weekly compensation for the injury. Medical men are called to give evidence for or against the injured workman.

=Epilepsy= is often simulated. The foaming at the mouth is produced by a piece of soap between the gums and the cheek. The true epileptic, especially if he suspects that a fit is imminent, takes his walks abroad in some secluded spot, whilst the impostor selects a crowded locality for his exertions. The epileptic often injures himself in falling, his imitator never; one bites his tongue, but the other carefully refrains from doing so. The skin of an epileptic during an attack is cold and pallid, but that of the exhibitor is covered with sweat as the result of his exertions. In epilepsy the urine and fæces are passed involuntarily, but his colleague rarely considers it necessary to carry his deception to this extent. In true epilepsy the eyes are partly open, with the eyeballs rolling and distorted, whilst the pupils are dilated and do not contract to light; the impostor keeps his eyes closed, and he cannot prevent the iris from contracting when a bicycle-lamp is flashed across his face. A useful test is to give the impostor a pinch of snuff, which promptly brings the entertainment to an end.

=Lumbago= is often feigned, and the imposture should be suspected when there is a motive, and when physical signs, such as nodes and tender spots, are absent. A simple test is to inadvertently drop a shilling in front of him, when he will promptly stoop and pick it up. The same principles apply to spurious sciatica.

=Hæmorrhages= purporting to come from the lungs, stomach, or bowels, rarely present much difficulty. The microscope is of use in all cases of bleeding. Possibly the gums or the inside of the cheeks may have been scratched or abraded with a pin.

=Skin Diseases= are excited artificially, especially those which may be produced by mechanical and chemical irritants. The most commonly employed are vinegar, acetic acid, carbolic acid, nitric acid, and carbonate of sodium; but tramps frequently use sorrel and various species of ranunculus. The lesions simulated are usually inflammatory in character, such as erythema, vesicular and bullous eruptions, and ulceration of the skin. They may be complicated by the presence of pediculi and other animal and vegetable parasites. Chromidrosis of the lower eyelids in young women often owes its origin to a box of paints. Factitious skin diseases are seen most commonly on the face and extremities, especially on the left side--in other words, on the most accessible parts of the body.

Feigned menstruation, pregnancy, abortion, and recent delivery are common, and should give rise to no difficulty. The same may be said of feigned insanity, aphonia, deaf-mutism, and loss of memory.

The following hints may be useful to a medical man when called to a supposed case of malingering: Do not be satisfied with one visit, but go again and unexpectedly; see that the patient is watched between the visits; make an objective examination, compare the indications with the statements of the patient, noting especially any discrepancies between his account of his symptoms and the real symptoms of disease; ask questions the reverse of the patient's statements, or take them for granted, and he will often be found to contradict himself; have all dressings and bandages removed; suggest, in the hearing of the patient, some heroic methods of treatment--the actual cautery, or severe surgical operation, for example; finally, chloroform will be found of great use in the detection of many sham diseases.

MOUNT HOFFMAN AND LAKE TENAYA

from *My First Summer in the Sierra*, by John Muir

EBook #32540

July 26. Ramble to the summit of Mount Hoffman, eleven thousand feet high, the highest point in life's journey my feet have yet touched. And what glorious landscapes are about me, new plants, new animals, new crystals, and multitudes of new mountains far higher than Hoffman, towering in glorious array along the axis of the range, serene, majestic, snow-laden, sun-drenched, vast domes and ridges shining below them, forests, lakes, and meadows in the hollows, the pure blue bell-flower sky brooding them all,--a glory day of admission into a new realm of wonders as if Nature had wooingly whispered, "Come higher." What questions I asked, and how little I know of all the vast show, and how eagerly, tremulously hopeful of some day knowing more, learning the meaning of these divine symbols crowded together on this wondrous page.

Mount Hoffman is the highest part of a ridge or spur about fourteen miles from the axis of the main range, perhaps a remnant brought into relief and isolated by unequal denudation. The southern slopes shed their waters into Yosemite Valley by Tenaya and Dome Creeks, the northern in part into the Tuolumne River, but mostly into the Merced by Yosemite Creek. The rock is mostly granite, with some small piles and crests rising here and there in picturesque pillared and castellated remnants of red metamorphic slates. Both the granite and slates are divided by joints, making them separable into blocks like the stones of artificial masonry, suggesting the Scripture "He hath builded the mountains." Great banks of snow and ice are piled in hollows on the cool precipitous north side forming the highest perennial sources of Yosemite Creek. The southern slopes are much more gradual and accessible. Narrow slot-like gorges extend across the summit at right angles, which look like lanes, formed evidently by the erosion of less resisting beds. They are usually called "devil's slides," though they lie far above the region usually haunted by the devil; for though we read that he once climbed an exceeding high mountain, he cannot be much of a mountaineer, for his tracks are seldom seen above the timber-line.

The broad gray summit is barren and desolate-looking in general views, wasted by ages of gnawing storms; but looking at the surface in detail, one finds it covered by thousands and millions of charming plants with leaves and flowers so small they form no mass of color visible at a distance of a few hundred yards. Beds of azure daisies smile confidingly in moist hollows, and along the banks of small rills, with several species of eriogonum, silky-leaved ivesia, pentstemon, orthocarpus, and

patches of *Primula suffruticosa*, a beautiful shrubby species. Here also I found bryanthus, a charming heathwort covered with purple flowers and dark green foliage like heather, and three trees new to me--a hemlock and two pines. The hemlock (*Tsuga Mertensiana*) is the most beautiful conifer I have ever seen; the branches and also the main axis droop in a singularly graceful way, and the dense foliage covers the delicate, sensitive, swaying branchlets all around. It is now in full bloom, and the flowers, together with thousands of last season's cones still clinging to the drooping sprays, display wonderful wealth of color, brown and purple and blue. Gladly I climbed the first tree I found to revel in the midst of it. How the touch of the flowers makes one's flesh tingle! The pistillate are dark, rich purple, and almost translucent, the staminate blue,--a vivid, pure tone of blue like the mountain sky,--the most uncommonly beautiful of all the Sierra tree flowers I have seen. How wonderful that, with all its delicate feminine grace and beauty of form and dress and behavior, this lovely tree up here, exposed to the wildest blasts, has already endured the storms of centuries of winters!

The two pines also are brave storm-enduring trees, the mountain pine (*Pinus monticola*) and the dwarf pine (*Pinus albicaulis*). The mountain pine is closely related to the sugar pine, though the cones are only about four to six inches long. The largest trees are from five to six feet in diameter at four feet above the ground, the bark rich brown. Only a few storm-beaten adventurers approach the summit of the mountain. The dwarf or white-bark pine is the species that forms the timber-line, where it is so completely dwarfed that one may walk over the top of a bed of it as over snow-pressed chaparral.

How boundless the day seems as we revel in these storm-beaten sky gardens amid so vast a congregation of onlooking mountains! Strange and admirable it is that the more savage and chilly and storm-chafed the mountains, the finer the glow on their faces and the finer the plants they bear. The myriads of flowers tingeing the mountain-top do not seem to have grown out of the dry, rough gravel of disintegration, but rather they appear as visitors, a cloud of witnesses to Nature's love in what we in our timid ignorance and unbelief call howling desert. The surface of the ground, so dull and forbidding at first sight, besides being rich in plants, shines and sparkles with crystals: mica, hornblende, feldspar, quartz, tourmaline. The radiance in some places is so great as to be fairly dazzling, keen lance rays of every color flashing, sparkling in glorious abundance, joining the plants in their fine, brave beauty-work--every crystal, every flower a window opening into heaven, a mirror reflecting the Creator.

From garden to garden, ridge to ridge, I drifted enchanted, now on my

knees gazing into the face of a daisy, now climbing again and again among the purple and azure flowers of the hemlocks, now down into the treasures of the snow, or gazing afar over domes and peaks, lakes and woods, and the billowy glaciated fields of the upper Tuolumne, and trying to sketch them. In the midst of such beauty, pierced with its rays, one's body is all one tingling palate. Who wouldn't be a mountaineer! Up here all the world's prizes seem nothing.

The largest of the many glacier lakes in sight, and the one with the finest shore scenery, is Tenaya, about a mile long, with an imposing mountain dipping its feet into it on the south side, Cathedral Peak a few miles above its head, many smooth swelling rock-waves and domes on the north, and in the distance southward a multitude of snowy peaks, the fountain-heads of rivers. Lake Hoffman lies shimmering beneath my feet, mountain pines around its shining rim. To the northward the picturesque basin of Yosemite Creek glitters with lakelets and pools; but the eye is soon drawn away from these bright mirror wells, however attractive, to revel in the glorious congregation of peaks on the axis of the range in their robes of snow and light.

Carlo caught an unfortunate woodchuck when it was running from a grassy spot to its boulder-pile home—one of the hardest of the mountain animals. I tried hard to save him, but in vain. After telling Carlo that he must be careful not to kill anything, I caught sight, for the first time, of the curious pika, or little chief hare, that cuts large quantities of lupines and other plants and lays them out to dry in the sun for hay, which it stores in underground barns to last through the long, snowy winter. Coming upon these plants freshly cut and lying in handfuls here and there on the rocks has a startling effect of busy life on the lonely mountain-top. These little haymakers, endowed with brain stuff something like our own,—God up here looking after them,—what lessons they teach, how they widen our sympathy!

An eagle soaring above a sheer cliff, where I suppose its nest is, makes another striking show of life, and helps to bring to mind the other people of the so-called solitude—deer in the forest caring for their young; the strong, well-clad, well-fed bears; the lively throng of squirrels; the blessed birds, great and small, stirring and sweetening the groves; and the clouds of happy insects filling the sky with joyous hum as part and parcel of the down-pouring sunshine. All these come to mind, as well as the plant people, and the glad streams singing their way to the sea. But most impressive of all is the vast glowing countenance of the wilderness in awful, infinite repose.

Toward sunset, enjoyed a fine run to camp, down the long south slopes, across ridges and ravines, gardens and avalanche gaps, through the firs

and chaparral, enjoying wild excitement and excess of strength, and so ends a day that will never end.

July 27. Up and away to Lake Tenaya,--another big day, enough for a lifetime. The rocks, the air, everything speaking with audible voice or silent; joyful, wonderful, enchanting, banishing weariness and sense of time. No longing for anything now or hereafter as we go home into the mountain's heart. The level sunbeams are touching the fir-tops, every leaf shining with dew. Am holding an easterly course, the deep cañon of Tenaya Creek on the right hand, Mount Hoffman on the left, and the lake straight ahead about ten miles distant, the summit of Mount Hoffman about three thousand feet above me, Tenaya Creek four thousand feet below and separated from the shallow, irregular valley, along which most of the way lies, by smooth domes and wave-ridges. Many mossy emerald bogs, meadows, and gardens in rocky hollows to wade and saunter through--and what fine plants they give me, what joyful streams I have to cross, and how many views are displayed of the Hoffman and Cathedral Peak masonry, and what a wondrous breadth of shining granite pavement to walk over for the first time about the shores of the lake! On I sauntered in freedom complete; body without weight as far as I was aware; now wading through starry parnassia bogs, now through gardens shoulder deep in larkspur and lilies, grasses and rushes, shaking off showers of dew; crossing piles of crystalline moraine boulders, bright mirror pavements, and cool, cheery streams going to Yosemite; crossing bryanthus carpets and the scoured pathways of avalanches, and thickets of snow-pressed ceanothus; then down a broad, majestic stairway into the ice-sculptured lake-basin.

The snow on the high mountains is melting fast, and the streams are singing bank-full, swaying softly through the level meadows and bogs, quivering with sun-spangles, swirling in pot-holes, resting in deep pools, leaping, shouting in wild, exulting energy over rough boulder dams, joyful, beautiful in all their forms. No Sierra landscape that I have seen holds anything truly dead or dull, or any trace of what in manufactories is called rubbish or waste; everything is perfectly clean and pure and full of divine lessons. This quick, inevitable interest attaching to everything seems marvelous until the hand of God becomes visible; then it seems reasonable that what interests Him may well interest us. When we try to pick out anything by itself, we find it hitched to everything else in the universe. One fancies a heart like our own must be beating in every crystal and cell, and we feel like stopping to speak to the plants and animals as friendly fellow mountaineers. Nature as a poet, an enthusiastic workingman, becomes more and more visible the farther and higher we go; for the mountains are fountains--beginning places, however related to sources beyond mortal ken.

I found three kinds of meadows: (1) Those contained in basins not yet filled with earth enough to make a dry surface. They are planted with several species of carex, and have their margins diversified with robust flowering plants such as veratrum, larkspur, lupine, etc. (2) Those contained in the same sort of basins, once lakes like the first, but so situated in relation to the streams that flow through them and beds of transportable sand, gravel, etc., that they are now high and dry and well drained. This dry condition and corresponding difference in their vegetation may be caused by no superiority of position, or power of transporting filling material in the streams that belong to them, but simply by the basin being shallow and therefore sooner filled. They are planted with grasses, mostly fine, silky, and rather short-leaved, *Calamagrostis* and *Agrostis* being the principal genera. They form delightfully smooth, level sods in which one finds two or three species of gentian and as many of purple and yellow orthocarpus, violet, vaccinium, kalmia, bryanthus, and Ionicera. (3) Meadows hanging on ridge and mountain slopes, not in basins at all, but made and held in place by masses of boulders and fallen trees, which, forming dams one above another in close succession on small, outspread, channelless streams, have collected soil enough for the growth of grasses, carices, and many flowering plants, and being kept well watered, without being subject to currents sufficiently strong to carry them away, a hanging or sloping meadow is the result. Their surfaces are seldom so smooth as the others, being roughened more or less by the projecting tops of the dam rocks or logs; but at a little distance this roughness is not noticed, and the effect is very striking--bright green, fluent, down-sweeping flowery ribbons on gray slopes. The broad shallow streams these meadows belong to are mostly derived from banks of snow and because the soil is well drained in some places, while in others the dam rocks are packed close and caulked with bits of wood and leaves, making boggy patches; the vegetation, of course, is correspondingly varied. I saw patches of willow, bryanthus, and a fine show of lilies on some of them, not forming a margin, but scattered about among the carex and grass. Most of these meadows are now in their prime. How wonderful must be the temper of the elastic leaves of grasses and sedges to make curves so perfect and fine. Tempered a little harder, they would stand erect, stiff and bristly, like strips of metal; a little softer, and every leaf would lie flat. And what fine painting and tinting there is on the glumes and pales, stamens and feathery pistils. Butterflies colored like the flowers waver above them in wonderful profusion, and many other beautiful winged people, numbered and known and loved only by the Lord, are waltzing together high over head, seemingly in pure play and hilarious enjoyment of their little sparks of life. How wonderful they are! How do they get a living, and endure the weather? How are their little bodies, with muscles, nerves, organs, kept warm and jolly in such

admirable exuberant health? Regarded only as mechanical inventions, how wonderful they are! Compared with these, Godlike man's greatest machines are as nothing.

Most of the sandy gardens on moraines are in prime beauty like the meadows, though some on the north sides of rocks and beneath groves of sapling pines have not yet bloomed. On sunny sheets of crystal soil along the slopes of the Hoffman Mountains, I saw extensive patches of ivesia and purple gilia with scarce a green leaf, making fine clouds of color. Ribes bushes, vaccinium, and kalmia, now in flower, make beautiful rugs and borders along the banks of the streams. Shaggy beds of dwarf oak (*Quercus chrysolepis*, var. *vaccinifolia*) over which one may walk are common on rocky moraines, yet this is the same species as the large live oak seen near Brown's Flat. The most beautiful of the shrubs is the purple-flowered bryanthus, here making glorious carpets at an elevation of nine thousand feet.

The principal tree for the first mile or two from camp is the magnificent silver fir, which reaches perfection here both in size and form of individual trees, and in the mode of grouping in groves with open spaces between. So trim and tasteful are these silvery, spiry groves one would fancy they must have been placed in position by some master landscape gardener, their regularity seeming almost conventional. But Nature is the only gardener able to do work so fine. A few noble specimens two hundred feet high occupy central positions in the groups with younger trees around them; and outside of these another circle of yet smaller ones, the whole arranged like tastefully symmetrical bouquets, every tree fitting nicely the place assigned to it as if made especially for it; small roses and eriogonums are usually found blooming on the open spaces about the groves, forming charming pleasure grounds. Higher, the firs gradually become smaller and less perfect, many showing double summits, indicating storm stress. Still, where good moraine soil is found, even on the rim of the lake-basin, specimens one hundred and fifty feet in height and five feet in diameter occur nearly nine thousand feet above the sea. The saplings, I find, are mostly bent with the crushing weight of the winter snow, which at this elevation must be at least eight or ten feet deep, judging by marks on the trees; and this depth of compacted snow is heavy enough to bend and bury young trees twenty or thirty feet in height and hold them down for four or five months. Some are broken; the others spring up when the snow melts and at length attain a size that enables them to withstand the snow pressure. Yet even in trees five feet thick the traces of this early discipline are still plainly to be seen in their curved insteps, and frequently in old dried saplings protruding from the trunk, partially overgrown by the new axis developed from a branch below the break. Yet through all this stress the forest is maintained in marvelous beauty.

Beyond the silver firs I find the two-leaved pine (*Pinus contorta*, var. *Murrayana*) forms the bulk of the forest up to an elevation of ten thousand feet or more--the highest timber-belt of the Sierra. I saw a specimen nearly five feet in diameter growing on deep, well-watered soil at an elevation of about nine thousand feet. The form of this species varies very much with position, exposure, soil, etc. On stream-banks, where it is closely planted, it is very slender; some specimens seventy-five feet high do not exceed five inches in diameter at the ground, but the ordinary form, as far as I have seen, is well proportioned. The average diameter when full grown at this elevation is about twelve or fourteen inches, height forty or fifty feet, the straggling branches bent up at the end, the bark thin and bedraggled with amber-colored resin. The pistillate flowers form little crimson rosettes a fourth of an inch in diameter on the ends of the branchlets, mostly hidden in the leaf-tassels; the staminate are about three eighths of an inch in diameter, sulphur-yellow, in showy clusters, giving a remarkably rich effect--a brave, hardy mountaineer pine, growing cheerily on rough beds of avalanche boulders and joints of rock pavements, as well as in fertile hollows, standing up to the waist in snow every winter for centuries, facing a thousand storms and blooming every year in colors as bright as those worn by the sun-drenched trees of the tropics.

A still hardier mountaineer is the Sierra juniper (*Juniperus occidentalis*), growing mostly on domes and ridges and glacier pavements. A thickset, sturdy, picturesque highlander, seemingly content to live for more than a score of centuries on sunshine and snow; a truly wonderful fellow, dogged endurance expressed in every feature, lasting about as long as the granite he stands on. Some are nearly as broad as high. I saw one on the shore of the lake nearly ten feet in diameter, and many six to eight feet. The bark, cinnamon-colored, flakes off in long ribbon-like strips with a satiny luster. Surely the most enduring of all tree mountaineers, it never seems to die a natural death, or even to fall after it has been killed. If protected from accidents, it would perhaps be immortal. I saw some that had withstood an avalanche from snowy Mount Hoffman cheerily putting out new branches, as if repeating, like Grip, "Never say die." Some were simply standing on the pavement where no fissure more than half an inch wide offered a hold for its roots. The common height for these rock-dwellers is from ten to twenty feet; most of the old ones have broken tops, and are mere stumps, with a few tufted branches, forming picturesque brown pillars on bare pavements, with plenty of elbow-room and a clear view in every direction. On good moraine soil it reaches a height of from forty to sixty feet, with dense gray foliage. The rings of the trunk are very thin, eighty to an inch of diameter in some specimens I examined. Those

ten feet in diameter must be very old--thousands of years. Wish I could live, like these junipers, on sunshine and snow, and stand beside them on the shore of Lake Tenaya for a thousand years. How much I should see, and how delightful it would be! Everything in the mountains would find me and come to me, and everything from the heavens like light.

The lake was named for one of the chiefs of the Yosemite tribe. Old Tenaya is said to have been a good Indian to his tribe. When a company of soldiers followed his band into Yosemite to punish them for cattle-stealing and other crimes, they fled to this lake by a trail that leads out of the upper end of the valley, early in the spring, while the snow was still deep; but being pursued, they lost heart and surrendered. A fine monument the old man has in this bright lake, and likely to last a long time, though lakes die as well as Indians, being gradually filled with detritus carried in by the feeding streams, and to some extent also by snow avalanches and rain and wind. A considerable portion of the Tenaya basin is already changed into a forested flat and meadow at the upper end, where the main tributary enters from Cathedral Peak. Two other tributaries come from the Hoffman Range. The outlet flows westward through Tenaya Cañon to join the Merced River in Yosemite. Scarce a handful of loose soil is to be seen on the north shore. All is bare, shining granite, suggesting the Indian name of the lake, Pywiack, meaning shining rock. The basin seems to have been slowly excavated by the ancient glaciers, a marvelous work requiring countless thousands of years. On the south side an imposing mountain rises from the water's edge to a height of three thousand feet or more, feathered with hemlock and pine; and huge shining domes on the east, over the tops of which the grinding, wasting, molding glacier must have swept as the wind does to-day.

July 28. No cloud mountains, only curly cirrus wisps scarce perceptible, and the want of thunder to strike the noon hour seems strange, as if the Sierra clock had stopped. Have been studying the _magnifica_ fir--measured one near two hundred and forty feet high, the tallest I have yet seen. This species is the most symmetrical of all conifers, but though gigantic in size it seldom lives more than four or five hundred years. Most of the trees die from the attacks of a fungus at the age of two or three centuries. This dry-rot fungus perhaps enters the trunk by way of the stumps of limbs broken off by the snow that loads the broad palmate branches. The younger specimens are marvels of symmetry, straight and erect as a plumb-line, their branches in regular level whorls of five mostly, each branch as exact in its divisions as a fern frond, and thickly covered by the leaves, making a rich plush over all the tree, excepting only the trunk and a small portion of the main limbs. The leaves turn upward, especially on the branchlets, and are stiff and sharp, pointed on all the upper portion of the tree. They

remain on the tree about eight or ten years, and as the growth is rapid it is not rare to find the leaves still in place on the upper part of the axis where it is three to four inches in diameter, wide apart of course, and their spiral arrangement beautifully displayed. The leaf-scars are conspicuous for twenty years or more, but there is a good deal of variation in different trees as to the thickness and sharpness of the leaves.

After the excursion to Mount Hoffman I had seen a complete cross-section of the Sierra forest, and I find that *Abies magnifica* is the most symmetrical tree of all the noble coniferous company. The cones are grand affairs, superb in form, size, and color, cylindrical, stand erect on the upper branches like casks, and are from five to eight inches in length by three or four in diameter, greenish gray, and covered with fine down which has a silvery luster in the sunshine, and their brilliance is augmented by beads of transparent balsam which seems to have been poured over each cone, bringing to mind the old ceremonies of anointing with oil. If possible, the inside of the cone is more beautiful than the outside; the scales, bracts, and seed wings are tinted with the loveliest rosy purple with a bright lustrous iridescence; the seeds, three fourths of an inch long, are dark brown. When the cones are ripe the scales and bracts fall off, setting the seeds free to fly to their predestined places, while the dead spike-like axes are left on the branches for many years to mark the positions of the vanished cones, excepting those cut off when green by the Douglas squirrel. How he gets his teeth under the broad bases of the sessile cones, I don't know. Climbing these trees on a sunny day to visit the growing cones and to gaze over the tops of the forest is one of my best enjoyments.

July 29. Bright, cool, exhilarating. Clouds about .05. Another glorious day of rambling, sketching, and universal enjoyment.

July 30. Clouds .20, but the regular shower did not reach us, though thunder was heard a few miles off striking the noon hour. Ants, flies, and mosquitoes seem to enjoy this fine climate. A few house-flies have discovered our camp. The Sierra mosquitoes are courageous and of good size, some of them measuring nearly an inch from tip of sting to tip of folded wings. Though less abundant than in most wildernesses, they occasionally make quite a hum and stir, and pay but little attention to time or place. They sting anywhere, any time of day, wherever they can find anything worth while, until they are themselves stung by frost. The large, jet-black ants are only ticklish and troublesome when one is lying down under the trees. Noticed a borer drilling a silver fir. Ovipositor about an inch and a half in length, polished and straight like a needle. When not in use, it is folded back in a sheath, which

extends straight behind like the legs of a crane in flying. This drilling, I suppose, is to save nest building, and the after care of feeding the young. Who would guess that in the brain of a fly so much knowledge could find lodgment? How do they know that their eggs will hatch in such holes, or, after they hatch, that the soft, helpless grubs will find the right sort of nourishment in silver fir sap? This domestic arrangement calls to mind the curious family of gallflies. Each species seems to know what kind of plant will respond to the irritation or stimulus of the puncture it makes and the eggs it lays, in forming a growth that not only answers for a nest and home but also provides food for the young. Probably these gallflies make mistakes at times, like anybody else; but when they do, there is simply a failure of that particular brood, while enough to perpetuate the species do find the proper plants and nourishment. Many mistakes of this kind might be made without being discovered by us. Once a pair of wrens made the mistake of building a nest in the sleeve of a workman's coat, which was called for at sundown, much to the consternation and discomfiture of the birds. Still the marvel remains that any of the children of such small people as gnats and mosquitoes should escape their own and their parents' mistakes, as well as the vicissitudes of the weather and hosts of enemies, and come forth in full vigor and perfection to enjoy the sunny world. When we think of the small creatures that are visible, we are led to think of many that are smaller still and lead us on and on into infinite mystery.

July 31. Another glorious day, the air as delicious to the lungs as nectar to the tongue; indeed the body seems one palate, and tingles equally throughout. Cloudiness about .05, but our ordinary shower has not yet reached us, though I hear thunder in the distance.

The cheery little chipmunk, so common about Brown's Flat, is common here also, and perhaps other species. In their light, airy habits they recall the familiar species of the Eastern States, which we admired in the oak openings of Wisconsin as they skimmed along the zigzag rail fences. These Sierra chipmunks are more arboreal and squirrel-like. I first noticed them on the lower edge of the coniferous belt, where the Sabine and yellow pines meet,--exceedingly interesting little fellows, full of odd, funny ways, and without being true squirrels, have most of their accomplishments without their aggressive quarrelsomeness. I never weary watching them as they frisk about in the bushes gathering seeds and berries, like song sparrows poising daintily on slender twigs, and making even less stir than most birds of the same size. Few of the Sierra animals interest me more; they are so able, gentle, confiding, and beautiful, they take one's heart, and get themselves adopted as darlings. Though weighing hardly more than field mice, they are laborious collectors of seeds, nuts, and cones, and are therefore well

fed, but never in the least swollen with fat or lazily full. On the contrary, of their frisky, birdlike liveliness there is no end. They have a great variety of notes corresponding with their movements, some sweet and liquid, like water dripping with tinkling sounds into pools. They seem dearly to love teasing a dog, coming frequently almost within reach, then frisking away with lively chipping, like sparrows, beating time to their music with their tails, which at each chip describe half circles from side to side. Not even the Douglas squirrel is surer-footed or more fearless. I have seen them running about on sheer precipices of the Yosemite walls seemingly holding on with as little effort as flies, and as unconscious of danger, where, if the slightest slip were made, they would have fallen two or three thousand feet. How fine it would be could we mountaineers climb these tremendous cliffs with the same sure grip! The venture I made the other day for a view of the Yosemite Fall, and which tried my nerves so sorely, this little *Tamias* would have made for an ear of grass.

The woodchuck (*Arctomys monax*) of the bleak mountain-tops is a very different sort of mountaineer--the most bovine of rodents, a heavy eater, fat, aldermanic in bulk and fairly bloated, in his high pastures, like a cow in a clover field. One woodchuck would outweigh a hundred chipmunks, and yet he is by no means a dull animal. In the midst of what we regard as storm-beaten desolation he pipes and whistles right cheerily, and enjoys long life in his skyland homes. His burrow is made in disintegrated rocks or beneath large boulders. Coming out of his den in the cold hoarfrost mornings, he takes a sun-bath on some favorite flat-topped rock, then goes to breakfast in garden hollows, eats grass and flowers until comfortably swollen, then goes a-visiting to fight and play. How long a woodchuck lives in this bracing air I don't know, but some of them are rusty and gray like lichen-covered boulders.

August 1. A grand cloudland and five-minute shower, refreshing the blessed wilderness, already so fragrant and fresh, steeping the black meadow mold and dead leaves like tea.

The waycup, or flicker, so familiar to every boy in the old Middle West States, is one of the most common of the wood-peckers hereabouts, and makes one feel at home. I can see no difference in plumage or habits from the Eastern species, though the climate here is so different,--a fine, brave, confiding, beautiful bird. The robin, too, is here, with all his familiar notes and gestures, tripping daintily on open garden spots and high meadows. Over all America he seems to be at home, moving from the plains to the mountains and from north to south, back and forth, up and down, with the march of the seasons and food supply. How admirable the constitution and temper of this brave singer, keeping in cheery health over so vast and varied a range! Oftentimes, as I wander

through these solemn woods, awe-stricken and silent, I hear the reassuring voice of this fellow wanderer ringing out, sweet and clear, "Fear not! fear not!"

The mountain quail (*Oreortyx ricta*) I often meet in my walks--a small brown partridge with a very long, slender, ornamental crest worn jauntily like a feather in a boy's cap, giving it a very marked appearance. This species is considerably larger than the valley quail, so common on the hot foothills. They seldom alight in trees, but love to wander in flocks of from five or six to twenty through the ceanothus and manzanita thickets and over open, dry meadows and rocks of the ridges where the forest is less dense or wanting, uttering a low clucking sound to enable them to keep together. When disturbed they rise with a strong birr of wing-beats, and scatter as if exploded to a distance of a quarter of a mile or so. After the danger is past they call one another together with a loud piping note--Nature's beautiful mountain chickens. I have not yet found their nests. The young of this season are already hatched and away--new broods of happy wanderers half as large as their parents. I wonder how they live through the long winters, when the ground is snow-covered ten feet deep. They must go down towards the lower edge of the forest, like the deer, though I have not heard of them there.

The blue, or dusky, grouse is also common here. They like the deepest and closest fir woods, and when disturbed, burst from the branches of the trees with a strong, loud whir of wing-beats, and vanish in a wavering, silent slide, without moving a feather--a stout, beautiful bird about the size of the prairie chicken of the old west, spending most of the time in the trees, excepting the breeding season, when it keeps to the ground. The young are now able to fly. When scattered by man or dog, they keep still until the danger is supposed to be passed, then the mother calls them together. The chicks can hear the call a distance of several hundred yards, though it is not loud. Should the young be unable to fly, the mother feigns desperate lameness or death to draw one away, throwing herself at one's feet within two or three yards, rolling over on her back, kicking and gasping, so as to deceive man or beast. They are said to stay all the year in the woods hereabouts, taking shelter in dense tufted branches of fir and yellow pine during snowstorms, and feeding on the young buds of these trees. Their legs are feathered down to their toes, and I have never heard of their suffering in any sort of weather. Able to live on pine and fir buds, they are forever independent in the matter of food, which troubles so many of us and controls our movements. Gladly, if I could, I would live forever on pine buds, however full of turpentine and pitch, for the sake of this grand independence. Just to think of our sufferings last month merely for grist-mill flour. Man seems to have more difficulty in gaining food

than any other of the Lord's creatures. For many in towns it is a consuming, lifelong struggle; for others, the danger of coming to want is so great, the deadly habit of endless hoarding for the future is formed, which smothers all real life, and is continued long after every reasonable need has been over-supplied.

On Mount Hoffman I saw a curious dove-colored bird that seemed half woodpecker, half magpie, or crow. It screams something like a crow, but flies like a woodpecker, and has a long, straight bill, with which I saw it opening the cones of the mountain and white-barked pines. It seems to keep to the heights, though no doubt it comes down for shelter during winter, if not for food. So far as food is concerned, these bird-mountaineers, I guess, can glean nuts enough, even in winter, from the different kinds of conifers; for always there are a few that have been unable to fly out of the cones and remain for hungry winter gleaners.

THE NIGHTINGALE
A CONVERSATION POEM, WRITTEN IN APRIL 1798

No cloud, no relique of the sunken day
Distinguishes the West, no long thin slip
Of sullen light, no obscure trembling hues.
Come, we will rest on this old mossy bridge!
You see the glimmer of the stream beneath,
Bur* hear no murmuring: it flows silently,
O'er its soft bed of verdure. All is still,
A balmy night! and though the stars be dim,
Yet let us think upon the vernal showers
That gladden the green earth, and we shall find
A pleasure in the dimness of the stars.
And hark! the Nightingale begins its song,
"Most musical, most melancholy" bird!
A melancholy bird? Oh! idle thought!
In Nature there is nothing melancholy.
But some night-wandering man whose heart was pierced
With the remembrance of a grievous wrong,
Or slow distemper, or neglected love,
(And so, poor wretch! fill'd all things with himself,
And made all gentle sounds tell back the tale
Of his own sorrow) he, and such as he,
First named these notes a melancholy strain.
And many a poet echoes the conceit;
Poet who hath been building up the rhyme
When he had better far have stretched his limbs
Beside a brook in mossy forest-dell,
By sun or moon-light, to the influxes
Of shapes and sounds and shifting elements
Surrendering his whole spirit, of his song
And of his fame forgetful! so his fame
Should share in Nature's immortality,
A venerable thing! and so his song
Should make all Nature lovelier, and itself
Be loved like Nature! But 'twill not be so;
And youths and maidens most poetical,
Who lose the deepening twilights of the spring
In ball-rooms and hot theatres, they still
Full of meek sympathy must heave their sighs
O'er Philomela's pity-pleading strains.

My Friend, and thou, our Sister! we have learnt
A different lore: we may not thus profane
Nature's sweet voices, always full of love
And joyance! 'Tis the merry Nightingale
That crowds, and hurries, and precipitates
With fast thick warble his delicious notes,
As he were fearful that an April night
Would be too short for him to utter forth
His love-chant, and disburthen his full soul
Of all its music!

And I know a grove
Of large extent, hard by a castle huge,
Which the great lord inhabits not; and so
This grove is wild with tangling underwood,
And the trim walks are broken up, and grass,
Thin grass and king-cups grow within the paths.
But never elsewhere in one place I knew
So many nightingales; and far and near,
In wood and thicket, over the wide grove,
They answer and provoke each other's songs,
With skirmish and capricious passagings,
And murmurs musical and swift jug jug,
And one low piping sound more sweet than all--
Stirring the air with such an harmony,
That should you close your eyes, you might almost
Forget it was not day! On moonlight bushes,
Whose dewy leaflets are but half-disclosed,
You may perchance behold them on the twigs,
Their bright, bright eyes, their eyes both bright and full,
Glistening, while many a glow-worm in the shade
Lights up her love-torch.

A most gentle Maid,
Who dwelleth in her hospitable home
Hard by the castle, and at latest eve
(Even like a Lady vowed and dedicate
To something more than Nature in the grove)
Glides through the pathways; she knows all their notes,
That gentle Maid! and oft, a moment's space,
What time the moon was lost behind a cloud,
Hath heard a pause of silence; till the moon
Emerging, hath awakened earth and sky
With one sensation, and those wakeful birds
Have all burst forth in choral minstrelsy,
As if some sudden gale had swept at once

A hundred airy harps! And she hath watched
Many a nightingale perch giddily
On blossomy twig still swinging from the breeze,
And to that motion tune his wanton song
Like tipsy joy that reels with tossing head.

Farewell, O Warbler! till to-morrow eve,
And you, my friends! farewell, a short farewell!
We have been loitering long and pleasantly,
And now for our dear homes.--That strain again!
Full fain it would delay me! My dear babe,
Who, capable of no articulate sound,
Mars all things with his imitative lisp,
How he would place his hand beside his ear,
His little hand, the small forefinger up,
And bid us listen! And I deem it wise
To make him Nature's play-mate. He knows well
The evening-star; and once, when he awoke
In most distressful mood (some inward pain
Had made up that strange thing, an infant's dream),
I hurried with him to our orchard-plot,
And he beheld the moon, and, hushed at once,
Suspends his sobs, and laughs most silently,
While his fair eyes, that swam with undropped
tears,
Did glitter in the yellow moon-beam! Well!--
It is a father's tale: But if that Heaven
Should give me life, his childhood shall grow up
Familiar with these songs, that with the night
He may associate joy.--Once more, farewell,
Sweet Nightingale! once more, my friends!
farewell.

from *Poems of Coleridge*, EBook #8208

FLEA-WORT.

from *The Complete Herbal*, by Nicholas Culpeper

EBook #49513

[Compiler's note: Don't Try This At Home -- this is ancient & potentially dangerous medicine!]

Descript.] ORDINARY Flea-wort rises up with a stalk two feet high or more, full of joints and branches on every side up to the top, and at every joint two small, long and narrow whitish green leaves somewhat hairy. At the top of every branch stand divers small, short scaly, or chaffy heads out of which come forth small whitish yellow threads, like to those of the Plantain herbs, which are the bloomings of flowers. The seed enclosed in these heads is small and shining while it is fresh, very like unto fleas both for colour and bigness, but turning black when it grows old. The root is not long, but white, hard and woody, perishing every year, and rising again of its own seed for divers years, if it be suffered to shed: The whole plant is somewhat whitish and hairy, smelling somewhat like rosin.

There is another sort hereof, differing not from the former in the manner of growing, but only that the stalk and branches being somewhat greater, do a little more bow down to the ground: The leaves are somewhat greater, the heads somewhat less, the seed alike; and the root and leaves abide all winter, and perish not as the former.

Place.] The first grows only in gardens, the second plentifully in fields that are near the sea.

Time.] They flower in July or thereabouts.

Government and virtues.] The herb is cold, and dry, and saturnine. I suppose it obtained the name of Flea-wort, because the seeds are so like Fleas. The seeds fried, and taken, stays the flux or lask of the belly, and the corrosions that come by reason of hot cholerick, or sharp and malignant humours, or by too much purging of any violent medicine, as Scammony, or the like. The mucilage of the seed made with Rose-water, and a little sugar-candy put thereto, is very good in all hot agues and burning fevers, and other inflammations, to cool the thirst, and lenify the dryness and roughness of the tongue and throat. It helps also hoarseness of the voice, and diseases of the breast and lungs, caused by heat, or sharp salt humours, and the pleurisy also. The mucilage of the seed made with Plantain water, whereunto the yoke of an egg or two, and a little Populeon are put, is a most safe and sure remedy to ease the sharpness, pricking, and pains of the hæmorrhoids or piles, if it be laid on a cloth, and bound thereto. It helps all inflammations in any part of the body, and the pains that

come thereby, as the headache and megrims, and all hot imposthumes, swellings, or breaking out of the skin, as blains, wheals, pushes, purples, and the like, as also the joints of those that are out of joint, the pains of the gout and sciatica, the burstings of young children, and the swellings of the navel, applied with oil of roses and vinegar. It is also good to heal the nipples and sore breasts of women, being often applied thereunto. The juice of the herb with a little honey put into the ears helps the running of them, and the worms breeding in them: The same also mixed with hog's grease, and applied to corrupt and filthy ulcers, cleanses them and heals them.

ALONG THE HILLSBOROUGH

by Bradford Torrey, from *A Florida Sketch-Book*
EBook #10760

Wherever a walker lives, he finds sooner or later one favorite road. So it was with me at New Smyrna, where I lived for three weeks. I had gone there for the sake of the river, and my first impulse was to take the road that runs southerly along its bank. At the time I thought it the most beautiful road I had found in Florida, nor have I seen any great cause since to alter that opinion. With many pleasant windings (beautiful roads are never straight, nor unnecessarily wide, which is perhaps the reason why our rural authorities devote themselves so madly to the work of straightening and widening),--with many pleasant windings, I say,

"The grace of God made manifest in curves,"

it follows the edge of the hammock, having the river on one side, and the forest on the other. It was afternoon when I first saw it. Then it is shaded from the sun, while the river and its opposite bank have on them a light more beautiful than can be described or imagined; a light--with reverence for the poet of nature be it spoken--a light that never was _except_ on sea or land. The poet's dream was never equal to it.

In a flat country stretches of water are doubly welcome. They take the place of hills, and give the eye what it craves,--distance; which softens angles, conceals details, and heightens colors,--in short, transfigures the world with its romancer's touch, and blesses us with illusion. So, as I loitered along the south road, I never tired of looking across the river to the long, wooded island, and over that to the line of sand-hills that marked the eastern rim of the East Peninsula, beyond which was the Atlantic. The white crests of the hills made the sharper points of the horizon line. Elsewhere clumps of nearer pine-trees intervened, while here and there a tall palmetto stood, or seemed to stand, on the highest and farthest ridge looking seaward. But particulars mattered little. The blue water, the pale, changeable grayish-green of the low island woods, the deeper green of the pines, the unnamable hues of the sky, the sunshine that flooded it all, these were beauty enough;--beauty all the more keenly enjoyed because for much of the way it was seen only by glimpses, through vistas of palmetto and live-oak. Sometimes the road came quite out of the woods, as it rounded a turn of the hammock. Then I stopped to gaze long at the scene. Elsewhere I pushed through the hedge at favorable points, and sat, or

stood, looking up and down the river. A favorite seat was the prow of an old row-boat, which lay, falling to pieces, high and dry upon the sand. It had made its last cruise, but I found it still useful.

The river is shallow. At low tide sandbars and oyster-beds occupy much of its breadth; and even when it looked full, a great blue heron would very likely be wading in the middle of it. That was a sight to which I had grown accustomed in Florida, where this bird, familiarly known as "the major," is apparently ubiquitous. Too big to be easily hidden, it is also, as a general thing, too wary to be approached within gunshot. I am not sure that I ever came within sight of one, no matter how suddenly or how far away, that it did not give evidence of having seen me first. Long legs, long wings, a long bill--and long sight and long patience: such is the tall bird's dowry. Good and useful qualities, all of them. Long may they avail to put off the day of their owner's extermination.

The major is scarcely a bird of which you can make a pet in your mind, as you may of the chickadee, for instance, or the bluebird, or the hermit thrush. He does not lend himself naturally to such imaginary endearments. But it is pleasant to have him on one's daily beat. I should count it one compensation for having to live in Florida instead of in Massachusetts (but I might require a good many others) that I should see him a hundred times as often. In walking down the river road I seldom saw less than half a dozen; not together (the major, like fishermen in general, is of an unsocial turn), but here one and there one,--on a sand-bar far out in the river, or in some shallow bay, or on the submerged edge of an oyster-flat. Wherever he was, he always looked as if he might be going to do something presently; even now, perhaps, the matter was on his mind; but at this moment--well, there are times when a heron's strength is to stand still. Certainly he seemed in no danger of overeating. A cracker told me that the major made an excellent dish if killed on the full of the moon. I wondered at that qualification, but my informant explained himself. The bird, he said, feeds mostly at night, and fares best with the moon to help him. If the reader would dine off roast blue heron, therefore, as I hope I never shall, let him mind the lunar phases. But think of the gastronomic ups and downs of a bird that is fat and lean by turns twelve times a year! Possibly my informant overstated the case; but in any event I would trust the major to bear himself like a philosopher. If there is any one of God's creatures that can wait for what he wants, it must be the great blue heron.

I have spoken of his caution. If he was patrolling a shallow on one side of an oyster-bar,--at the rate, let us say, of two steps a minute,--and took it into his head (an inappropriate phrase, as conveying an idea of something like suddenness) to try the water on the other side, he did

not spread his wings, as a matter of course, and fly over. First he put up his head--an operation that makes another bird of him--and looked in all directions. How could he tell what enemy might be lying in wait? And having alighted on the other side (his manner of alighting is one of his prettiest characteristics), he did not at once draw in his neck till his bill protruded on a level with his body, and resume his labors, but first he looked once more all about him. It was a good habit to do that, anyhow, and he meant to run no risks. If "the race of birds was created out of innocent, light-minded men, whose thoughts were directed toward heaven," according to the word of Plato, then Ardea herodias must long ago have fallen from grace. I imagine his state of mind to be always like that of our pilgrim fathers in times of Indian massacres. When they went after the cows or to hoe the corn, they took their guns with them, and turned no corner without a sharp lookout against ambush. No doubt such a condition of affairs has this advantage, that it makes ennui impossible. There is always something to live for, if it be only to avoid getting killed.

After this manner did the Hillsborough River majors all behave themselves until my very last walk beside it. Then I found the exception,--the exception that is as good as inevitable in the case of any bird, if the observation be carried far enough. He (or she; there was no telling which it was) stood on the sandy beach, a splendid creature in full nuptial garb, two black plumes nodding jauntily from its crown, and masses of soft elongated feathers draping its back and lower neck. Nearer and nearer I approached, till I must have been within a hundred feet; but it stood as if on dress parade, exulting to be looked at. Let us hope it never carried itself thus gayly when the wrong man came along.

Near the major--not keeping him company, but feeding in the same shallows and along the same oyster-bars--were constantly to be seen two smaller relatives of his, the little blue heron and the Louisiana. The former is what is called a dichromatic species; some of the birds are blue, and others white. On the Hillsborough, it seemed to me that white specimens predominated; but possibly that was because they were so much more conspicuous. Sunlight favors the white feather; no other color shows so quickly or so far. If you are on the beach and catch sight of a bird far out at sea,--a gull or a tern, a gannet or a loon,--it is invariably the white parts that are seen first. And so the little white heron might stand never so closely against the grass or the bushes on the further shore of the river, and the eye could not miss him. If he had been a blue one, at that distance, ten to one he would have escaped me. Besides, I was more on the alert for white ones, because I was always hoping to find one of them with black legs. In other words, I was looking for the little white egret, a bird concerning which, thanks to

the murderous work of plume-hunters,--thanks, also, to those good women who pay for having the work done,--I must confess that I went to Florida and came home again without certainly seeing it.

The heron with which I found myself especially taken was the Louisiana; a bird of about the same size as the little blue, but with an air of daintiness and lightness that is quite its own, and quite indescribable. When it rose upon the wing, indeed, it seemed almost _too_ light, almost unsteady, as if it lacked ballast, like a butterfly. It was the most numerous bird of its tribe along the river, I think, and, with one exception, the most approachable. That exception was the green heron, which frequented the flats along the village front, and might well have been mistaken for a domesticated bird; letting you walk across a plank directly over its head while it squatted upon the mud, and when disturbed flying into a fig-tree before the hotel piazza, just as the dear little ground doves were in the habit of doing. To me, who had hitherto seen the green heron in the wildest of places, this tameness was an astonishing sight. It would be hard to say which surprised me more, the New Smyrna green herons or the St. Augustine sparrow-hawks, --which latter treated me very much as I am accustomed to being treated by village-bred robins in Massachusetts.

The Louisiana heron was my favorite, as I say, but incomparably the handsomest member of the family (I speak of such as I saw) was the great white egret. In truth, the epithet "handsome" seems almost a vulgarism as applied to a creature so superb, so utterly and transcendently splendid. I saw it--in a way to be sure of it--only once. Then, on an island in the Hillsborough, two birds stood in the dead tops of low shrubby trees, fully exposed in the most favorable of lights, their long dorsal trains drooping behind them and swaying gently in the wind. I had never seen anything so magnificent. And when I returned, two or three hours afterward, from a jaunt up the beach to Mosquito Inlet, there they still were, as if they had not stirred in all that time. The reader should understand that this egret is between four and five feet in length, and measures nearly five feet from wing tip to wing tip, and that its plumage throughout is of spotless white. It is pitiful to think how constantly a bird of that size and color must be in danger of its life.

Happily, the lawmakers of the State have done something of recent years for the protection of such defenseless beauties. Happily, too, shooting from the river boats is no longer permitted,--on the regular lines, that is. I myself saw a young gentleman stand on the deck of an excursion steamer, with a rifle, and do his worst to kill or maim every living thing that came in sight, from a spotted sandpiper to a turkey buzzard! I call him a "gentleman;" he was in gentle company, and the fact that he

chewed gum industriously would, I fear, hardly invalidate his claim to that title. The narrow river wound in and out between low, densely wooded banks, and the beauty of the shifting scene was enough almost to take one's breath away; but the crack of the rifle was not the less frequent on that account. Perhaps the sportsman was a Southerner, to whom river scenery of that enchanting kind was an old story. More likely he was a Northerner, one of the men who thank Heaven they are "not sentimental."

In my rambles up and down the river road I saw few water birds beside the herons. Two or three solitary cormorants would be shooting back and forth at a furious rate, or swimming in midstream; and sometimes a few spotted sandpipers and killdeer plovers were feeding along the shore. Once in a great while a single gull or tern made its appearance,--just often enough to keep me wondering why they were not there oftener,--and one day a water turkey went suddenly over my head and dropped into the river on the farther side of the island. I was glad to see this interesting creature for once in salt water; for the Hillsborough, like the Halifax and the Indian rivers, is a river in name only,--a river by brevet,--being, in fact, a salt-water lagoon or sound between the mainland and the eastern peninsula.

Fish-hawks were always in sight, and bald eagles were seldom absent altogether. Sometimes an eagle stood perched on a dead tree on an island. Oftener I heard a scream, and looked up to see one sailing far overhead, or chasing an osprey. On one such occasion, when the hawk seemed to be making a losing fight, a third bird suddenly intervened, and the eagle, as I thought, was driven away. "Good for the brotherhood of fish-hawks!" I exclaimed. But at that moment I put my glass on the new-comer; and behold, he was not a hawk, but another eagle. Meanwhile the hawk had disappeared with his fish, and I was left to ponder the mystery.

As for the wood, the edge of the hammock, through which the road passes, there were no birds in it. It was one of those places (I fancy every bird-gazer must have had experience of such) where it is a waste of time to seek them. I could walk down the road for two miles and back again, and then sit in my room at the hotel for fifteen minutes, and see more wood birds, and more kinds of them, in one small live-oak before the window than I had seen in the whole four miles; and that not once and by accident, but again and again. In affairs of this kind it is useless to contend. The spot looks favorable, you say, and nobody can deny it; there must be birds there, plenty of them; your missing them to-day was a matter of chance; you will try again. And you try again--and again--and yet again. But in the end you have to acknowledge that, for some reason unknown to you, the birds have agreed to give that place the

go-by.

One bird, it is true, I found in this hammock, and not elsewhere: a single oven-bird, which, with one Northern water thrush and one Louisiana water thrush, completed my set of Florida _Seiuri_. Besides him I recall one hermit thrush, a few cedar-birds, a house wren, chattering at a great rate among the "bootjacks" (leaf-stalks) of an overturned palmetto-tree, with an occasional mocking-bird, cardinal grosbeak, prairie warbler, yellow redpoll, myrtle bird, ruby-crowned kinglet, phoebe, and flicker. In short, there were no birds at all, except now and then an accidental straggler of a kind that could be found almost anywhere else in indefinite numbers.

And as it was not the presence of birds that made the river road attractive, so neither was it any unwonted display of blossoms. Beside a similar road along the bank of the Halifax, in Daytona, grew multitudes of violets, and goodly patches of purple verbena (garden plants gone wild, perhaps), and a fine profusion of spiderwort,--a pretty flower, the bluest of the blue, thrice welcome to me as having been one of the treasures of the very first garden of which I have any remembrance. "Indigo plant," we called it then. Here, however, on the way from New Smyrna to Hawks Park, I recall no violets, nor any verbena or spiderwort. Yellow wood-sorrel (*oxalis*) was here, of course, as it was everywhere. It dotted the grass in Florida very much as five-fingers do in Massachusetts, I sometimes thought. And the creeping, round-leaved *houstonia* was here, with a superfluity of a weedy blue sage (*Salvia lyrata*). Here, also, as in Daytona, I found a strikingly handsome tufted plant, a highly varnished evergreen, which I persisted in taking for a fern--the sterile fronds--in spite of repeated failures to find it described by Dr. Chapman under that head, until at last an excellent woman came to my help with the information that it was "coontie" (*Zamia integrifolia*), famous as a plant out of which the Southern people made bread in war time. This confession of botanical amateurishness and incompetency will be taken, I hope, as rather to my credit than otherwise; but it would be morally worthless if I did not add the story of another plant, which, in this same New Smyrna hammock, I frequently noticed hanging in loose bunches, like blades of flaccid deep green grass, from the trunks of cabbage palmettos. The tufts were always out of reach, and I gave them no particular thought; and it was not until I got home to Massachusetts, and then almost by accident, that I learned what they were. They, it turned out, were ferns (*Vittaria lineata*--grass fern), and my discomfiture was complete.

This comparative dearth of birds and flowers was not in all respects a disadvantage. On the contrary, to a naturalist blessed now and then with a supernaturalistic mood, it made the place, on occasion, a welcome

retreat. Thus, one afternoon, as I remember, I had been reading Keats, the only book I had brought with me,--not counting manuals, of course, which come under another head,--and by and by started once more for the pine lands by the way of the cotton-shed hammock, "to see what I could see." But poetry had spoiled me just then for anything like scientific research, and as I waded through the ankle-deep sand I said to myself all at once, "No, no! What do I care for another new bird? I want to see the beauty of the world." With that I faced about, and, taking a side track, made as directly as possible for the river road. There I should have a mind at ease, with no unfamiliar, tantalizing bird note to set my curiosity on edge, nor any sand through which to be picking my steps.

The river road is paved with oyster-shells. If any reader thinks that statement prosaic or unimportant, then he has never lived in southern Florida. In that part of the world all new-comers have to take walking-lessons; unless, indeed, they have already served an apprenticeship on Cape Cod, or in some other place equally arenarious. My own lesson I got at second hand, and on a Sunday. It was at New Smyrna, in the village. Two women were behind me, on their way home from church, and one of them was complaining of the sand, to which she was not yet used. "Yes," said the other, "I found it pretty hard walking at first, but I learned after a while that the best way is to set the heel down hard, as hard as you can; then the sand doesn't give under you so much, and you get along more comfortably." I wonder whether she noticed, just in front of her, a man who began forthwith to bury his boot heel at every step?

In such a country (the soil is said to be good for orange-trees, but they do not have to walk) roads of powdered shell are veritable luxuries, and land agents are quite right in laying all stress upon them as inducements to possible settlers. If the author of the Apocalypse had been raised in Florida, we should never have had the streets of the New Jerusalem paved with gold. His idea of heaven, would have been different from that; more personal and home-felt, we may be certain.

The river road, then, as I have said, and am glad to say again, was shell-paved. And well it might be; for the hammock, along the edge of which it meandered, seemed, in some places at least, to be little more than a pile of oyster-shells, on which soil had somehow been deposited, and over which a forest was growing. Florida Indians have left an evil memory. I heard a philanthropic visitor lamenting that she had talked with many of the people about them, and had yet to hear a single word said in their favor. Somebody might have been good enough to say that, with all their faults, they had given to eastern Florida a few hills, such as they are, and at present are supplying it, indirectly, with comfortable highways. How they must have feasted, to leave such heaps of

shells behind them! They came to the coast on purpose, we may suppose. Well, the red-men are gone, but the oyster-beds remain; and if winter refugees continue to pour in this direction, as doubtless they will, they too will eat a "heap" of oysters (it is easy to see how the vulgar Southern use of that word may have originated), and in the course of time, probably, the shores of the Halifax and the Hillsborough will be a fine mountainous country! And then, if this ancient, nineteenth-century prediction is remembered, the highest peak of the range will perhaps be named in a way which the innate modesty of the prophet restrains him from specifying with greater particularity.

Meanwhile it is long to wait, and tourists and residents alike must find what comfort they can in the lesser hills which, thanks to the good appetite of their predecessors, are already theirs. For my own part, there is one such eminence of which I cherish the most grateful recollections. It stands (or stood; the road-makers had begun carting it away) at a bend in the road just south of one of the Turnbull canals. I climbed it often (it can hardly be less than fifteen or twenty feet above the level of the sea), and spent more than one pleasant hour upon its grassy summit. Northward was New Smyrna, a village in the woods, and farther away towered the lighthouse of Mosquito Inlet. Along the eastern sky stretched the long line of the peninsula sand-hills, between the white crests of which could be seen the rude cottages of Coronado beach. To the south and west was the forest, and in front, at my feet, lay the river with its woody islands. Many times have I climbed a mountain and felt myself abundantly repaid by an off-look less beautiful. This was the spot to which I turned when I had been reading Keats, and wanted to see the beauty of the world. Here were a grassy seat, the shadow of orange-trees, and a wide prospect. In Florida, I found no better place in which a man who wished to be both a naturalist and a nature-lover, who felt himself heir to a double inheritance,

"The clear eye's moiety and the dear heart's part,"

could for the time sit still and be happy.

The orange-trees yielded other things beside shadow, though perhaps nothing better than that. They were resplendent with fruit, and on my earlier visits were also in bloom. One did not need to climb the hill to learn the fact. For an out-of-door sweetness it would be hard, I think, to improve upon the scent of orange blossoms. As for the oranges themselves, they seemed to be in little demand, large and handsome as they were. Southern people in general, I fancy, look upon wild fruit of this kind as not exactly edible. I remember asking two colored men in Tallahassee whether the oranges still hanging conspicuously from a tree just over the wall (a sight not so very common in that part of the

State) were sweet or sour. I have forgotten just what they said, but I remember how they looked. I meant the inquiry as a mild bit of humor, but to them it was a thousandfold better than that: it was wit ineffable. What Shakespeare said about the prosperity of a jest was never more strikingly exemplified. In New Smyrna, with orange groves on every hand, the wild fruit went begging with natives and tourists alike; so that I feel a little hesitancy about confessing my own relish for it, lest I should be accused of affectation. Not that I devoured wild oranges by the dozen, or in place of sweet ones; one sour orange goes a good way, as the common saying is; but I ate them, nevertheless, or rather drank them, and found them, in a thirsty hour, decidedly refreshing.

The unusual coldness of the past season (Florida winters, from what I heard about them, must have fallen of late into a queer habit of being regularly exceptional) had made it difficult to buy sweet oranges that were not dry and "punky"[1] toward the stem; but the hardier wild fruit had weathered the frost, and was so juicy that, as I say, you did not so much eat one as drink it. As for the taste, it was a wholesome bitter-sour, as if a lemon had been flavored with quinine; not quite so sour as a lemon, perhaps, nor quite so bitter as Peruvian bark, but, as it were, an agreeable compromise between the two. When I drank one, I not only quenched my thirst, but felt that I had taken an infallible prophylactic against the malarial fever. Better still, I had surprised myself. For one who had felt a lifelong distaste, unsocial and almost unmanly, for the bitter drinks which humanity in general esteems so essential to its health and comfort, I was developing new and unexpected capabilities; than which few things can be more encouraging as years increase upon a man's head, and the world seems to be closing in about him.

[Footnote 1: I have heard this useful word all my life, and now am surprised to find it wanting in the dictionaries.]

Later in the season, on this same shell mound, I might have regaled myself with fresh figs. Here, at any rate, was a thrifty-looking fig-tree, though its crop, if it bore one, would perhaps not have waited my coming so patiently as the oranges had done. Here, too, was a red cedar; and to me, who, in my ignorance, had always thought of this tough little evergreen as especially at home on my own bleak and stony hillsides, it seemed an incongruous trio,--fig-tree, orange-tree, and savin. In truth, the cedars of Florida were one of my liveliest surprises. At first I refused to believe that they were red cedars, so strangely exuberant were they, so disdainful of the set, cone-shaped, toy-tree pattern on which I had been used to seeing red cedars built. And when at last a study of the flora compelled me to admit their

identity,[1] I turned about and protested that I had never seen red cedars before. One, in St. Augustine, near San Marco Avenue, I had the curiosity to measure. The girth of the trunk at the smallest place was six feet five inches, and the spread of the branches was not less than fifty feet.

[Footnote 1: I speak as if I had accepted my own study of the manual as conclusive. I did for the time being, but while writing this paragraph I bethought myself that I might be in error, after all. I referred the question, therefore, to a friend, a botanist of authority. "No wonder the red cedars of Florida puzzled you," he replied. "No one would suppose at first that they were of the same species as our New England savins. The habit is entirely different; but botanists have found no characters by which to separate them, and you are safe in considering them as *Juniperus Virginiana*."]]

The stroller in this road suffered few distractions. The houses, two or three to the mile, stood well back in the woods, with little or no cleared land about them. Picnic establishments they seemed to a Northern eye, rather than permanent dwellings. At one point, in the hammock, a rude camp was occupied by a group of rough-looking men and several small children, who seemed to be getting on as best they could--none too well, to judge from appearances--without feminine ministrations. What they were there for I never made out. They fished, I think, but whether by way of amusement or as a serious occupation I did not learn. Perhaps, like the Indians of old, they had come to the river for the oyster season. They might have done worse. They never paid the slightest attention to me, nor once gave me any decent excuse for engaging them in talk. The best thing I remember about them was a tableau caught in passing. A "norther" had descended upon us unexpectedly (Florida is not a whit behind the rest of the world in sudden changes of temperature), and while hastening homeward, toward nightfall, hugging myself to keep warm, I saw, in the woods, this group of campers disposed about a lively blaze.

Let us be thankful, say I, that memory is so little the servant of the will. Chance impressions of this kind, unforeseen, involuntary, and inexplicable, make one of the chief delights of traveling, or rather of having traveled. In the present case, indeed, the permanence of the impression is perhaps not altogether beyond the reach of a plausible conjecture. We have not always lived in houses; and if we love the sight of a fire out-of-doors,--a camp-fire, that is to say,--as we all do, so that the burning of a brush-heap in a neighbor's yard will draw us to the window, the feeling is but part of an ancestral inheritance. We have come by it honestly, as the phrase is. And so I need not scruple to set down another reminiscence of the same kind,--an early morning street

scene, of no importance in itself, in the village of New Smyrna. It may have been on the morning next after the "norther" just mentioned. I cannot say. We had two or three such touches of winter in early March; none of them at all distressing, be it understood, to persons in ordinary health. One night water froze,—"as thick as a silver dollar,"—and orange growers were alarmed for the next season's crop, the trees being just ready to blossom. Some men kept fires burning in their orchards overnight; a pretty spectacle, I should think, especially where the fruit was still ungathered. On one of these frosty mornings, then, I saw a solitary horseman, not "wending his way," but warming his hands over a fire that he had built for that purpose in the village street. One might live and die in a New England village without seeing such a sight. A Yankee would have betaken himself to the corner grocery. But here, though that "adjunct of civilization" was directly across the way, most likely it had never had a stove in it. The sun would give warmth enough in an hour,—by nine o'clock one would probably be glad of a sunshade; but the man was chilly after his ride; it was still a bit early to go about the business that had brought him into town: what more natural than to hitch his horse, get together a few sticks, and kindle a blaze? What an insane idea it would have seemed to him that a passing stranger might remember him and his fire three months afterward, and think them worth talking about in print! But then, as was long ago said, it is the fate of some men to have greatness thrust upon them.

This main street of the village, by the way, with its hotels and shops, was no other than my river road itself, in its more civilized estate, as I now remember with a sense of surprise. In my mind the two had never any connection. It was in this thoroughfare that one saw now and then a group of cavaliers strolling about under broad-brimmed hats, with big spurs at their heels, accosting passers-by with hearty familiarity, first names and hand-shakes, while their horses stood hitched to the branches of roadside trees,—a typical Southern picture. Here, on a Sunday afternoon, were two young fellows who had brought to town a mother coon and three young ones, hoping to find a purchaser. The guests at the hotels manifested no eagerness for such pets, but the colored bell-boys and waiters gathered about, and after a little good-humored dickering bought the entire lot, box and all, for a dollar and a half; first having pulled the little ones out between the slats—not without some risk to both parties—to look at them and pass them round. The venders walked off with grins of ill-concealed triumph. The Fates had been kind to them, and they had three silver half-dollars in their pockets. I heard one of them say something about giving part of the money to a third man who had told them where the nest was; but his companion would listen to no such folly. "He wouldn't come with us," he said, "and we won't tell him a damned thing." I fear there was nothing distinctively Southern about _that_.

Here, too, in the heart of the town, was a magnificent cluster of live-oaks, worth coming to Florida to see; far-spreading, full of ferns and air plants, and heavy with hanging moss. Day after day I went out to admire them. Under them was a neglected orange grove, and in one of the orange-trees, amid the glossy foliage, appeared my first summer tanager. It was a royal setting, and the splendid vermilion-red bird was worthy of it. Among the oaks I walked in the evening, listening to the strange low chant of the chuck-will's-widow,--a name which the owner himself pronounces with a rest after the first syllable. Once, for two or three days, the trees were amazingly full of blue yellow-backed warblers. Numbers of them, a dozen at least, could be heard singing at once directly over one's head, running up the scale not one after another, but literally in unison. Here the tufted titmouse, the very soul of monotony, piped and piped and piped, as if his diapason stop were pulled out and stuck, and could not be pushed in again. He is an odd genius. With plenty of notes, he wearies you almost to distraction, harping on one string for half an hour together. He is the one Southern bird that I should perhaps be sorry to see common in Massachusetts; but that "perhaps" is a large word. Many yellow-throated warblers, silent as yet, were commonly in the live-oaks, and innumerable myrtle birds, also silent, with prairie warblers, black-and-white creepers, solitary vireos, an occasional chickadee, and many more. It was a birdy spot; and just across the way, on the shrubby island, were red-winged blackbirds, who piqued my curiosity by adding to the familiar _conkaree_ a final syllable,--the Florida termination, I called it,--which made me wonder whether, as has been the case with so many other Florida birds, they might not turn out to be a distinct race, worthy of a name (_Agelaius phoeniceus something-or-other_), as well as of a local habitation. I suggest the question to those whose business it is to be learned in such matters.[1]

[Footnote 1: My suggestion, I now discover,--since this paper was first printed,--was some years too late. Mr. Ridgway, in his _Manual of North American Birds_ (1887), had already described a subspecies of Florida redwings under the name of _Agelaius phoeniceus bryanti_. Whether my New Smyrna birds should come under that title cannot be told, of course, in the absence of specimens; but on the strength of the song I venture to think it highly probable.]

The tall grass about the borders of the island was alive with clapper rails. Before I rose in the morning I heard them crying in full chorus; and now and then during the day something would happen, and all at once they would break out with one sharp volley, and then instantly all would be silent again. Theirs is an apt name,--_Rallus crepitans_. Once I watched two of them in the act of crepitating, and ever after that, when

the sudden uproar burst forth, I seemed to see the reeds full of birds, each with his bill pointing skyward, bearing his part in the salvo. So, far as I could perceive, they had nothing to fear from human enemies. They ran about the mud on the edge of the grass, especially in the morning, looking like half-grown pullets. Their specialty was crab-fishing, at which they were highly expert, plunging into the water up to the depth of their legs, and handling and swallowing pretty large specimens with surprising dexterity. I was greatly pleased with them, as well as with their local name, "everybody's chickens."

Once I feared we had heard the last of them. On a day following a sudden fall of the mercury, a gale from the north set in at noon, with thunder and lightning, hail, and torrents of rain. The river was quickly lashed into foam, and the gale drove the ocean into it through the inlet, till the shrubbery of the rails' island barely showed above the breakers. The street was deep under water, and fears were entertained for the new bridge and the road to the beach. All night the gale continued, and all the next day till late in the afternoon; and when the river should have been at low tide, the island was still flooded. Gravitation was overmatched for the time being. And where were the rails, I asked myself. They could swim, no doubt, when put to it, but it seemed impossible that they could survive so fierce an inundation. Well, the wind ceased, the tide went out at last; and behold, the rails were in full cry, not a voice missing! How they had managed it was beyond my ken.

Another island, farther out than that of the rails (but the rails, like the long-billed marsh wrens, appeared to be present in force all up and down the river, in suitable places), was occupied nightly as a crow-roost. Judged by the morning clamor, which, like that of the rails, I heard from my bed, its population must have been enormous. One evening I happened to come up the street just in time to see the hinder part of the procession--some hundreds of birds--flying across the river. They came from the direction of the pine lands in larger and smaller squads, and with but a moderate amount of noise moved straight to their destination. All but one of them so moved, that is to say. The performance of that one exception was a mystery. He rose high in the air, over the river, and remained soaring all by himself, acting sometimes as if he were catching insects, till the flight had passed, even to the last scattering detachments. What could be the meaning of his eccentric behavior? Some momentary caprice had taken him, perhaps. Or was he, as I could not help asking, some duly appointed officer of the day,--grand marshal, if you please,--with a commission to see all hands in before retiring himself? He waited, at any rate, till the final stragglers had passed; then he came down out of the air and followed them. I meant to watch the ingathering a second time, to see whether

this feature of it would be repeated, but I was never there at the right moment. One cannot do everything.

Now, alas, Florida seems very far off. I am never likely to walk again under those New Smyrna live-oaks, nor to see again all that beauty of the Hillsborough. And yet, in a truer and better sense of the word, I do see it, and shall. What a heavenly light falls at this moment on the river and the island woods! Perhaps we must come back to Wordsworth, after all,--

"The light that never was, on sea or land."
